The London School of Economics and Political Science

MURKY WATERS

INFRASTRUCTURE, INFORMALITY AND REFORM IN DELHI

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DECLARATION

I certify that the thesis I have presented for examination for the MPhil/PhD degree of the London School of Economics and Political Science is solely my own work other than where I have clearly indicated that it is the work of others (in which case the extent of any work carried out jointly by me and any other person is clearly identified in it).

I warrant that this authorisation does not, to the best of my belief, infringe the rights of any third party.

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ABSTRACT

This thesis contributes a rich empirical analysis of urban water governance in Delhi, with particular attention to informality, groundwater and reforms. My research aims to develop understanding of the relationships between reforms, under both private sector management and a new progressive government, and existing informal water arrangements, particularly groundwater use, which households rely on in the absence of adequate public sector supply. I draw on interviews with 150 residents, as well as water suppliers, project officials, government staff, politicians and party workers over 18 months of multi-sited research in South Delhi's unauthorised colonies and urban villages. I use the idea of 'informal infrastructures' or 'infrastructural informality' connects my empirical research across different sites and scales. Bringing ideas from the literature on informality and infrastructures together under this framing offers modifications to the ways that 'informality' and 'infrastructures' are often understood and used. I use informality in this way 'as a method' to focus on the contingently enacted, materially and socially constituted character of various infrastructure processes.

I analyse the informal governance and politics of water supply at three difference sites and scales. Within Delhi's government network at an all-city level I note the formally and informally differentiated nature of the network and the challenges of knowledge and control of it. Outside of the piped network, I examine the decentralised infrastructures of tubewells and water tankers, primarily in the South Delhi areas of Sangam Vihar and Deoli. These decentralised supply modes are socially embedded in systems of party politics, caste and land-ownership with a range of opportunities for discretion, patronage and misallocation. They illustrate the connection and contrasts between informality in different resources, such as land and water, and infrastructures. I then examine an additional layer of urban water governance, in a Public Private Partnership (PPP) for urban water reform, in a zone around the Malviya Nagar area, also in South Delhi. I argue that the complexity of India's urban social hydrology, even in wealthy areas, has been underestimated by this initiative, and that despite an evolution of the PPP model concerns over the project's equity and viability remain. The high level of informality across different infrastructural systems in my research sites suggests the coexistence of a submerged 'technopolitics' operating through bureaucratic and technical modes of governance, with both overt and covert uses of intercession, personalisation and force.

The study makes contributions to knowledge in the following areas: informal urban water supply in India, particularly in unauthorised colonies and urban villages, in a region of high groundwater use, its relationship to water supply reforms from both government and a multinational public-private partnership.

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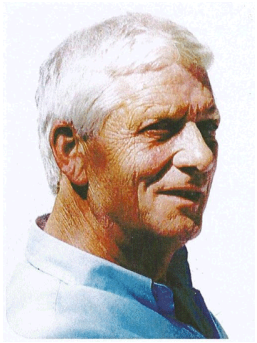
1945-2014



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For Mum

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HINDI AND INDIAN ENGLISH WORDS

Basti – Hindi, noun. settlement, used for JJ clusters and slums
Bore – borewell / tubewell
Crore – ten million
Dalit – low caste person, formerly 'untouchable'
Jhuggi-jhompri – self built low-income house
Kholnewala – tubewell manager
Lakh – one hundred thousand
Motor – water pump
Pradhan – local leader
Tanker – water tanker, delivery truck
Tank – water tank, both large open air reservoirs and household plastic storage containers

LIST OF ACRONYMS

AAP - AAM AADMI PARTY
ADB - ASIAN DEVELOPMENT BANK
AMRUT - ATAL MISSION FOR REJUVENATION AND URBAN TRANSFORMATION
BJP - BHARATIYA JANATA PARTY
BPS - BOOSTER PUMPING STATION
CEO - CHIEF EXECUTIVE OFFICER
CGWB - CENTRAL GROUND WATER BOARD
DDA - DELHI DEVELOPMENT AUTHORITY
DJB - DELHI JAL (WATER) BOARD
DMA - DISTRICT METERING AREA / DEMAND MANAGEMENT AREA
DMC - DELHI MUNICIPAL CORPORATION (NOW TRIFURCATED)
DPR - DETAILED PROJECT REPORT
DUWSSIP - DELHI URBAN WATER SUPPLY AND SEWERAGE IMPROVEMENT PROJECT
GIS - GEOGRAPHICAL INFORMATION SYSTEMS
INC - INDIAN NATIONAL CONGRESS
JICA - JAPANESE INTERNATIONAL COOPERATION AGENCY
JJC - JHUGI JHOMPRI CLUSTER
JNNURM - JAWAHARLAL NEHRU NATIONAL URBAN RENEWAL MISSION
LPCD - LITRES PER CAPITA PER DAY
MCD - MUNICIPAL CORPORATION OF DELHI (NOW SPLIT INTO NORTH, SOUTH AND EAST)
MGD - MILLION GALLONS DAILY
MLA - MEMBER OF LEGISLATIVE ASSEMBLY (ELECTED STATE GOVERNMENT POLITICIAN)
MLD - MILLION LITRES A DAY
MNC - MULTINATIONAL COMPANY
MNWS - MALVIYA NAGAR WATER SERVICES
MP - MEMBER OF PARLIAMENT
NCR - NATIONAL CAPITAL REGION
NCT - NATIONAL CAPITAL TERRITORY
NGO - NON-GOVERNMENTAL ORGANISATION
NRW - NON REVENUE WATER (THEFT)
PPP - PUBLIC PRIVATE PARTNERSHIP
PSP - PRIVATE SECTOR PARTICIPATION
PVC - POLYVINYL CHLORIDE
PWC - PRICEWATERHOUSE COOPERS
RO - REVERSE OSMOSIS
₹ - INDIAN RUPEES
RWA - RESIDENT WELFARE ASSOCIATION
SPML - SPML INFRA LIMITED, INFRASTRUCTURE COMPANY
UGR - UNDERGROUND SERVICE RESERVOIR
UK - UNITED KINGDOM
WTP - WATER TREATMENT PLANT

CHAPTER 1. INTRODUCTION

This thesis contributes a rich empirical analysis of urban water in Delhi, with particular attention to informality, groundwater and reforms. My work breaks new ground by analysing a range of common features of urban water in India – informal groundwater use, decentralised infrastructures (such as tubewells and tankers), and private sector network management – and their relation to urban governance and politics. I introduce the idea of 'informal infrastructures', which connects my empirical research across different sites and scales.

This introduction consists of four sections: a rationale for the research; a summary of the contribution; background on Delhi; and an outline of the thesis structure.

RATIONALE

Inadequate access to water kills a lot of people, mostly poor, mostly children, mostly in the global south (UN World Water Assessment Programme, 2006). Annual deaths from water borne diseases number in the millions and exceed those from malaria, armed conflict or the projected effects of climate change (UN World Water Assessment Programme, 2006, p. 18; P. P. Mollinga, 2007, p. 1235; E. Swyngedouw, 2006, p. 4; World Health Organization, 2017). In South Asia up to 15% of annual deaths are attributed to inadequate water and sanitation (World Health Organization, 2012, p. 7). The burden of inadequate water and sanitation falls disproportionately on women and girls (UNDP, 2006).

Water is also an urban issue; of over a billion people globally without access to 'adequate' water supply one in four is an urban resident (UN World Water Assessment Programme, 2006). The scale and speed of urbanisation, which exceeds spatial planning and infrastructure provision, make water and sanitation a key present and future urban challenge (Bakker 2008:1891).

Water is also an issue of political ecology. The water challenges of urbanisation are primarily of distribution, not absolute scarcity (L. Mehta, 2005). At the same time, a discourse of crisis is used to support further big infrastructure development and resource extraction from rural areas through a 'supply management approach' (Giglioli & Swyngedouw, 2008). The failure of public and private sector to adequately provide for poor people leads to a proliferating informal sector and further resources degradation. For example, eight of the world's ten most water stressed cities rely on water pumped from underground aquifers (McDonald et al., 2014). Yet, the use of urban groundwater to cope with inadequate water supply is 'largely unexplored' and 'has not been the topic of sustained research' (Grönwall, Mulenga, & McGranahan, 2010, p. 3).

Water security in South Asia will be a critical challenge over the next half-century (Chellaney, 2011; Gleeson, Wada, Bierkens, & van Beek, 2012; Rodell, Velicogna, & Famiglietti, 2009). Groundwater exhaustion, glacial melt and increasingly short and erratic monsoons are an already present threat for the region's rapidly growing urban areas and agricultural production (T. Shah, 2009). Rising climate variability and declining groundwater coupled with India's increasing population, urbanisation and inequality are likely to lead to severe human and economic development impacts (see e.g. Cronin, Prakash, Sridhar, & Coates, 2016; C. B. Kumar, 2013; Laghari, Vanham, & Rauch, 2012; Moors et al., 2011). This makes water access and equality increasingly urgent in the region.

In June 2015, Indian Prime Minister Narendra Modi appeared on a well-decorated stage in New Delhi, exactly a year after his swearing in ceremony, to formally announce three ambitious new urban programmes for India: Smart Cities Mission, AMRUT[1] and Housing for All. In addition to e-governance and redevelopment projects, a key component of Smart Cities and AMRUT has been stated as uninterrupted power and water supplies. Initial statements show enthusiasm for Public-Private-Partnerships (PPPs). The consequent deepening of private sector engagement in urban planning, development and services is being seen by international observers as a golden opportunity for business (Dezan Shira &

[1] Atal Mission for Rejuvenation and Urban Transformation. Atal Vajpayee (1924-) was the first BJP Prime Minister of India. This scheme continues much of the work of the Jawaharlal Nehru National Urban Renewal Mission.

Associates, 2016; Hypercat, 2015; UK Trade & Investment, 2015). The challenge of 'reforming' water supply will be central for Indian urban development, policy and politics.

However, to date, despite support at higher levels of government (and amongst international donors and development agencies), private involvement in Indian water supply has presented considerable challenges. The number of initiatives has been increasing since the small number of early water privatisation projects in the 1990s (including Navi Mumbai and Tirrupur). Since the late 90's water projects with the private sector have been cancelled in Hyderabad, Goa, Pune, Bangalore (twice), Delhi, Maharashtra, and Mumbai (Economic and Political Weekly, 2015). From the mid-2000s, a 'second wave' of water projects has been taking place (Nagpur, Hubli-Dharwad, Pimpri-Chinchwad)[2]. Nevertheless, a recent article describes the number of PPP projects and percentage of the country's population served as 'insignificant' (X. Wu, House, & Peri, 2016). Advocates of commercialisation offer a story of institutional learning and improvements in viability, but, in addition to technical challenges, political opposition continue to be a significant obstacle for projects involving the private sector (Bretton Woods Project, 2015; World Bank, 2012). Some research suggests that informal governance arrangements for water supply are likely to be a key element of these difficulties (N. Anand, 2015; Bawa, 2013; Björkman, 2015; M.-H. Zérah, 2000; Sami, Weinstein, & Shatkin, 2013). We have at first glance the 'clash of rationalities' between technocratic market-oriented governance and the prevalence of everyday informal practices (Watson, 2003, 2009).

Although a feature of daily life for many people, alternatives to official water supply are little studied in the academic literature on urban India. 'Informal water' is primarily pumped from below ground and India's groundwater is being extracted at some of the fastest rates in the world. 70% of India's irrigation, 80% of domestic and 85% of drinking water needs in India are met with groundwater. Groundwater is the major water source across all uses (Cullet, 2012), yet, as mentioned above, urban groundwater is little studied in social science and this 'underground political ecology' of water, both sub-soil and illicit, is under-explored in research to date (Bebbington, 2012; T. L. Birkenholtz, 2015; Grönwall et al., 2010). Across

[2] The NGO Manthan has compiled one of the most extensive lists of early water privatisation initiatives in India (Dwivedi, 2010).

North-West India, groundwater levels have been falling dramatically since the introduction of tubewell technology in the 1970s (Kulkarni & Shah, 2013). Estimates for urban use in the country as whole suggest that groundwater accounts for around 50% of water used (M. Shah, 2014, p. 11). Studies already show dangerous levels of depletion (Rodell et al., 2009). Groundwater demand is expected to exceed supply by 2020 (T. Birkenholtz, 2008; Cullet, 2012; World Bank, 2010). Delhi is an extreme case of this depletion and the second largest water stressed city globally (McDonald et al., 2014). However, while the economics and politics of rural groundwater use has been a rising area of research for some time (Dubash, 2001; T. Shah, 2008; T. Birkenholtz, 2009b), urban groundwater use has been relatively ignored, even 'a blind spot' (M. Shah, 2014).

Delhi is situated at the apex of North India's extreme groundwater depletion. India is the world's largest user of groundwater and the upper Ganges aquifer is being depleted at some the fastest rates in the world, along with California and Syria (Cullet, 2014; Gleeson et al., 2012). Indeed, Cullet states that "groundwater is now the main source of water for all major water uses in India" (Cullet, 2012 my italics). Much of the country's urban system relies on heavy groundwater use (Kulkarni, Vijay Shankar, & Krishnan, 2011). Delhi, along with many large and medium cities, and the majority of smaller towns, is also highly groundwater dependent. This is an important point of commonality with the urbanising parts of India where transformation is taking place the fastest, the potential opportunities for impact are highest, and the need is greatest. While in Delhi groundwater accounts for only 11 percent of the total raw water supply to the Delhi Jal Board, some researchers suggest it accounts for almost 50 percent of the volume received by the end users (Maria 2006). Groundwater use, as a supplement to inadequate public supply, in peri-urban, unplanned areas of Delhi is particularly extensive and weakly regulated. Indeed, unauthorised neighbourhoods are often reliant on groundwater from formal and informal sources.

High groundwater use as a consequence of unreliable public supply forms the background for controversial recent reforms in Delhi. One set of initiatives intends to improve public water supply by transforming it into viable commercial venture, while others more recently introduced provide a 'lifeline' quantity of water for free. Efforts to make public water

supply financially viable in Delhi through public-private partnerships began in 2012. After Delhi's December 2013 elections, the new government under the Aam Aadmi (Common Man) Party (AAP), which had campaigned on corruption and improvements in basic services and is led by an appropriately ordinary-looking former tax official, NGO worker and anti-water privatisation campaigner, Arvind Kejriwal, managed to gain enough seats to form a minority government and began attempts to transform Delhi's water policy in a more progressive direction (Naqvi, 2017).

Thus formal and informal politics, at city and neighbourhood level, becomes intrinsically enmeshed in understanding the governance of Delhi's water. Previous research suggests that populist policies and local business interests may subvert attempts at water commercialisation (N. Anand, 2011; Björkman, 2011; Contractor, 2012; Kacker & Joshi, 2012; Ranganathan, 2014a; M.-H. Zérah, 2000), yet there is little academic research on how relations between water dealers, politicians and residents influence urban water supply improvements and very little on the role of urban groundwater (Maria, 2006; Rohilla, 2012).

Despite being India's capital, around 50% of Delhi's population do not have access to piped water. Even for those that do, official supply operates on a rotating basis of a few hours a day with preferential treatment for 'better connected' areas. Families without adequate supply depend on illegal connections, illicit bore-wells and the 'tanker mafia' to access water that is frequently unsafe, expensive or simply unavailable. This has negative effects on people's health, education and livelihoods (particularly for women and children) (Datta, 2012, pp. 114–145). This situation is by no means unique to Delhi and appears to be a facet of public services in many less developed cities.

CONTRIBUTIONS

In this thesis, I treat water reforms under Delhi's new AAP government and a Public Private Partnership in the city as a 'diagnostic event' around which social relations are disturbed and realigned. This allows me to examine the ways water reform may reshuffle the distribution of water, modes of access, and methods of negotiation (Das, 1996; Jensen & Winthereik, 2013; Tarlo, 2003).

The thesis makes several original research contributions. Empirically, I add to work on the informal political economy of urban groundwater use, new models of private sector water management, and the relationships between urban groundwater and reforms. I additionally contribute to research on governance and urban services in unauthorised colonies and urban villages. Conceptually, I introduce the idea of 'informal infrastructures' as a theoretical frame and methodological approach, which connects my fieldwork across sites and scales. Practically, my project studies how the interactions of reform initiatives with the complexities of the existing water governance environment shape the possibilities for better water access and management.

I use the concept of informal infrastructures to connect my empirical material. Both informality and infrastructures are understood relationally: as terms that must be defined in context. Thus informal infrastructures include both urban services at a distance from official regulation (such as private water tankers, private tubewells and illegal bottled water factories) and *informalised* official infrastructures (such as diverted public water tankers, captured government tubewells and modifications to the official piped network). The informal infrastructures of interpersonal arrangement that often mediate access to urban services (administratively or physically), that others have called 'people as infrastructure', 'zero degree' or 'invisible' infrastructures[3] are an additional area of my research (De Boeck & Plissart, 2004, p. 235; Simone, 2004). In this way I use 'informality as a method' to direct attention towards the contingent, assembled and enacted nature of infrastructures.

Bringing informality and infrastructure together brings fresh perspectives to both. Research on infrastructure can contribute to work on informality by introducing different dynamics to work on spatial planning and livelihoods. Infrastructure studies also foregrounds complex material and technical realities that may be overlooked by more theoretically oriented urban scholarship. Informality, like infrastructure (see below) is relational, meaning that what, when, where and why a practice is informal is a question of definition. This understanding forces us to attend to empirical processes and practices. Thinking about

[3] Or more simply 'brokers' (e.g. I. M. Cook, 2015; Schindler, 2017). This literature is discussed in Chapter Two.

informality leads us to question the boundaries of concepts such as 'the state', 'the economy', 'politics' and 'infrastructure'. By virtue of its knowing relationship towards, and exploitation of, these boundaries, informality is inherently tied up with questions of power, to evade as much as enforce. A focus on smaller technologies (tubewells, tankers, tanks, filters), often used in the global south, provides a different perspective to work on public networks and other large technical systems.

My treatment of the reforms under a PPP model and the new Delhi government as a 'diagnostic event' provides a novel approach to understanding the social ecology of urban groundwater use and its relationship to water reforms and urban governance. I employ the idea of informality 'as method' to investigate the challenges to infrastructure reform initiatives as the neat models of planners become drawn into the mud of actually existing material and social realities. Writing on neoliberalisation and rationalisation projects forms a conceptual background to my work (Brenner, 2004; Ferguson, 1994; Mitchell, 2002; Mosse, 2004; Scott, 1998). However I am as keen to understand the close texture of the 'local' situations into which these reforms insert themselves as the projects themselves (Gopakumar, 2011; Walters, 2013). Moving beyond the arenas of state policy processes and NGO-mediated pilot projects, opens up a wide array of practices relevant to the successful implementation, and challenge, of reforms.

My research aims to develop empirical and analytic understandings of the relationships between 'informal' water supply, water sector reforms and urban governance in New Delhi. The thesis builds on recent work in social science, which treats water as a perspective on state-society relationships in India. I introduce two factors currently under-researched in the literature: use of groundwater as a supplement to government water supply and private sector reforms. I use the recent election of a progressive government, and the introduction of a PPP project to investigate the relationships between modes of 'formal' and 'informal' water supply in the context of reform. I use 'informal' here to refer to any method of water access that does not comply with official procedures and regulations (e.g. registered and billed by the official agency and paid for the by the consumer according to correct use and current tariff levels). My aim is to understand *how* and *why* 'informal' water supply, public

sector reform and PPPs, work in particular ways, and what they can tell us about water as a measure of social relations.

DELHI BACKGROUND

There are compelling reasons to research infrastructural informality through urban water (and groundwater) use and governance in Delhi. The National Capital Territory of Delhi is India's fastest growing metro, with a growth rate of 46.31% from 1991-2001, against a national average of 21.34% (Dutta et al 2005:440). The NCT population is currently estimated at 19 million making it the world's fifth largest megalopolis. Growth is considerably faster at the edges of the city and is slowing or declining in the centre, as with almost all other Indian cities (Kundu and Sivaramakrishnan 2007). Delhi's water system struggles with the pressures of fast urbanisation, fragmented governance, political interference and a limited budget.

The six metropolitan cities (Mumbai, Delhi, Bangalore, Chennai, Kolkata, Hyderabad) are already well represented in literature on urban India (Harris, 2012; McFarlane, 2013; Roy, 2009a). However, Delhi, the only 'megacity' in North India, with no natural barriers to growth, is also one of the only major cities to continue displaying high rates of growth, similar to India's smaller urban centres (Sivaramakrishnan, Kundu, & Singh, 2007). Also, unlike Bangalore or Chennai, Delhi has access to a very high quantity of water is provided on average, so a natural scarcity of water is not the issue. Delhi also has good access to funding, expertise, and political influence – which should be favourable conditions for good water supply. However, water supply is sufficiently uneven and unreliable that it can be seen as 'a typical example of a city with an unreliable water supply, both in respect with quantity and quality' (Marie-Hélène Zérah, 2000a).

Despite being India's capital, Delhi's water supply is below average. In a survey of water services in seven major Indian cities, Delhi was ranked worst with the exception of Kanpur, (Shaban & Sharma, 2007). Although definitive figures are not available (and official figures vary) educated estimates place the proportion of population relying on piped supply from the Delhi government at around 50% (Jain, 2012; Maria, 2008; Narain, 2011). Between 1994

and 2004 Delhi's water network increased by three percent to 1.09 million connections. Population in the city over the same period grew by 50% (Narain, 2011, p. 84). Relatively newer areas at the edges of the city (such as Noida, Dwarka, Nangloi and Sangam Vihar) have little or no public water service.

Delhi also has a large, and growing, 'informal' city where people born in the city, and those drawn from the vast semi-rural hinterland and beyond, struggle to make a foothold. This situation is due to a combination of fast urban and population growth, restrictive urban planning following the 1962 Master Plan, and the failure of the Delhi Development Authority (DDA) – under the Central Government, not Delhi Government, and more concerned with making profits and land banking than public housing – to provide more than a token amount of lower-income housing (Bhan, 2013). 'Informal' areas are often said to house 70% of the city population (Kundu and Sivaramakrishnan 2007). Urban services, including water, to these different kinds of neighbourhoods are differentially provided depending on planning status of the location (see Chapter Four). In 2009, 75% of the city population were served by the official water network of pipes, wells and hand pumps, while 24.5% of the population received government water from tankers only (CAG 2009). Informal water access is widespread. There are, however, multiple water supply reform projects with the private sector and international agencies, which allow contrast between different approaches to water governance. Further, Delhi has recently elected a new unorthodox political party, the Aam Aadmi Party (AAP), into government – partly on a mandate of improved water supply.

Delhi might be described as the 'battleground' of three governments. As the national capital, Delhi is occupied by the Government (or Union) of India (GoI) otherwise known as the Central Government ('Centre' is commonly used). Delhi's police force remains under Central government control, as does the Delhi Development Authority (DDA), the parastatal with the mandate to develop housing and manage land in Delhi (see, e.g. Bhan 2011, Ghertner 2015). Secondly, actual governance of Delhi is executed by a State Assembly ('State'), equivalent to the other states in India's federal system such as Maharashtra, Karnataka, Uttar Pradesh, etc. Politicians elected to the State Assembly are known as Members of the Legislative Assembly (or 'MLA' in popular use). Thirdly, Delhi has five

municipal governments or Urban Local Bodies (ULBs). The Municipal Corporation of Delhi (MCD) was trifurcated in 2009 into: South Delhi Municipal Corporation (SDMC); North Delhi Municipal Corporation (NDC); and East Delhi Municipal Corporation (EDMC). New Delhi (the Lutyen's Delhi 'bungalow zone', housing senior politicians, the very wealthy, foreign dignitaries, parliament, government offices etc) and Delhi Cantonment (military housing) are also governed by separate bodies; New Delhi Municipal Corporation (NDMC) and Delhi Cantonment Board (DCB). Politicians elected to Delhi's municipal governments are known as counsellors. This layer of governance is more junior in the hierarchy, with responsibility for cleaning of *nallas*[4] and collection of waste.

Official public water supply in Delhi ('government water') is the mandate of the Delhi Jal[5] Board (DJB). The DJB is a para-statal body, nominally separate from the State and Municipal Governments, but still headed by Delhi's Chief Minister (CM), the most senior politician in the Delhi State Government (for a longer history of the DJB's formation, see Chapter Four). This parastatal corporate-structure approach to water supply was instituted after liberalisation in the 1990s, in dialogue with international agencies. Popular opposition to the involvement of the private sector in Delhi's water however meant that introducing corporate investment and expertise was delayed, limited and tightly controlled. In formal terms, Delhi does not have a water policy as such (Delhi Jal Board, 2016b, p. 8). The closest thing would be the Delhi Jal Board Act (1984). Various documents stating the policies of the DJB, such as water tariffs, procedures for requesting a new connection, ordering a water tanker, and the yearly summer action plan of measures to address water shortage during the hot weather, are available on the DJB website[6]. Water tariffs are the responsibility of the State Assembly. Previously very low and below the cost of supply, since 2010 they have been subject to fixed increases of 10% a year. Provision of water, although under the DJB overall, becomes the responsibility of different government agencies according to the planning status of receiving areas. Although formally headed by Delhi's Chief Minister, the DJB is managed by a CEO, usually a senior Indian Administrative Service (IAS) bureaucrat. In 2015, under the new AAP government, the DJB began to address the lack of a formal policy

[4] Hindi n. drains at the sides of the street, uncovered or with concrete slabs laid over, but not piped. Carrying sewage, sullage, rainwater etc

[5] *jal* is a Sanskrit-derived Hindi noun for water

[6] http://delhi.gov.in/wps/wcm/connect/DOIT_DJB/djb/home/

by releasing a white paper and then a draft policy (Lalchandani, 2015b). The document states:

> Presently, Delhi does not have a water policy. While DJB is the organization with the largest mandate in Delhi's water sector, it does not have the sole and exclusive mandate. There are several organizations and factors within and without Delhi which have substantial influence, directly or indirectly, over Delhi's water sector. Fragments of a medium term strategy exist but these are not comprehensive or cogently organized. (Delhi Jal Board, 2016b, p. 8)

This Draft Policy provides a list of 'major unaddressed areas'. These include: 'lack of emphasis on demand management' (listed twice), 'efficient use of resource', 'conservation and augmentation of the groundwater reserves', 'ensuring adequate water supply to all sections of the population', 'equity in distribution spatially and amongst economic classes', 'sourcing supplies from distant basins in the face of increasing local resistance'. It should be clear that many of these align with the arguments of this thesis.

Delhi's water system is in a constant state of flux, both material and political. During much of my fieldwork period, Delhi's politics were unsettled. The latest, and very significant, change in Delhi's water provision is the emergence of a new political party, the Aam Aadmi (common man) Party (AAP), onto India's political scene.

> "I tell people, 'We don't *do* politics. We want to *change* politics'."
> (Fieldnote 117, interview with AAP MLA, DJB Head Office, 24/08/2015)

A central campaign of the AAP promise was to free people from dependence on the brokerage of 'vote bank' politics; the requirement for political intercession to access even low quality urban services (see Chapter Two). The current Chief Minister of Delhi is Arvind Kejriwal, formerly an Indian Revenue Service bureaucrat and social activist involved with the Indian Against Corruption movement and the NGO Parivartan in campaigning for services for low-income communities in Delhi. Kejriwal has been a prominent opponent of the privatisation of Delhi's water. After coming to power, the AAP introduced a number of significant initiatives aimed at reforming Delhi's water supply in a progressive, pro-poor direction.

In February 2014 the AAP resigned from government citing obstruction from rivals Indian National Congress and Bharatiya Janata Party (BJP) at State, Municipal and Federal levels. This first period in office has become known as 'the 49 days' (30 December 2013 to 17 February 2014). Following their resignation, the Delhi State Assembly was placed in 'suspended animation' and the capital was given over to President's Rule by Lieutenant Governor Najeeb Jung. This meant that the work of the State Assembly and elected representatives at this level (MLAs) was temporarily frozen. This allowed the major parties to focus their strengths on national elections until a new round of Delhi state elections was held in November 2015. On 10 February 2015, the Delhi State Assembly election results showed the AAP with a historical landslide victory. The AAP formed a second government with an almost total majority; 67 of the 70 constituencies elected AAP MLAs with just three going to the BJP opposition.

Under the AAP Government, Kapil Mishra, formerly one of CM Kejriwal's closest colleagues, was appointed DJB Vice Chairman and Water Minister[7]. Mishra has previously worked as a public relations officer with Greenpeace and Amnesty International and has been a prominent campaigner against the Commonwealth Games in Delhi and degradation of the Yamuna river. I met with Kapil three or four times, chatted and ate with him and observed him working in his office, but he would not give an interview and deputed a junior member of his staff to talk to me about their work. One of the strongest themes in this interview was the difficulty of working with a fragmented and baroque governance structure which required coordination between agencies and individuals with a complex division of responsibilities whose interests were not always, to put it mildly, aligned. Other ethnographic work on the AAP has described difficulty in policy implementation as a 'central contention' of their politics since coming to power.

> The party claims that they find it hard to implement their people centred policies that they had been voted in for in 2015. During my time in the MLA's office this

[7] In 2016 Mishra was dismissed as Water Resources Minister and his AAP party membership was suspended. He claimed that his removal was retaliation for his investigation into corruption in DJB tanker hiring, which he alleged involves current AAP politicians as well as the previous government. AAP politicians claim he is following a BJP 'script' (his mother is BJP Mayor for East Delhi). Although these allegations of high level corruption, political intrigue and inadequate regulation of outsourced government contracts are relevant they are outside the scope of this project. The issue has been given extensive media coverage (J. Anand & Pillai, 2017; Kaushika & Dutta, 2017; The Indian Express, 2017a).

> complaint surfaced almost every day. The volunteers in the office burst into a frustrated tirade every time they faced a resident's complaint that they found no instant solution for. "What can we do, the police is not with us, MCD is not under us and we have no control of the DDA." (Perczel, 2016, pp. 24–25)

In September 2017, with Mishra's successor hinting at 'massive mismanagement' and 'politicisation' within the DJB, Kejriwal took on the role of Water Minister himself (Times of India, 2017). Despite the challenges they face, the AAP has begun to make decisive and far-reaching changes to Delhi's water governance. They have introduced a set of progressive water reforms, with strong input from water professionals and campaigners, rather than the commercial orientation that usually dominates. For example, the AAP government reduced the cost of water connections for unauthorised colonies, introduced a limited amount of household water as a free 'lifeline' free water tariff block, and made it possible to apply for a water connection regardless of tenure status (Bhan, 2016). They have also attempted to counter corruption in the DJB, the prevalence of informal water supply, and stated their opposition to further privatisation of water in Delhi. After the AAP government coming to power, the DJB has laid pipelines and released piped water in 101 unauthorised colonies and pipelines have been laid in another 1033 unauthorised colonies.

OUTLINE OF THESIS

My project aims to understand the (spatial and social) patterns of water access and governance in South Delhi, through documenting the presence and characteristics of the urban informal water economy, and effects of recent reforms on access, supply and governance for users and suppliers.

In *Chapter Two, Literature*, I outline three bodies of literature that my study both draws on and contributes to: research on water reforms, particularly in India; research on infrastructures, especially water supply; and research on urban informality and informal politics.

Chapter Three, Methods, discusses my research design and the methods used. I open with a brief overview of my research questions and objectives, then discuss the specific areas of

Delhi that I chose to work in and the process of gaining access. I move on to the reasons for using my specific research tools: interviews, group interviews, participant observation. In closing, I consider research ethics and positionality, and some limitations of my project.

Chapter Four, Government Water builds an argument in response to the question of how Delhi's public water supply is governed, and why it appears to be so uneven and unreliable. Areas of the city with different planning statuses are allocated differential quantities of water, through different supply modes. The water supply actually delivered, however, varies even further. There appears to be no way of tracking water distribution, supply to consumers, revenue and losses across the city. Provision of water from the DJB appears susceptible to 'informal' influence at a range of scales as a result of lobbying by politicians, neighbourhood groups and individual households. The resulting unreliability has led to the system being physically modified in many ways, including unauthorised changes to the piped network and ubiquitous private household infrastructures such as pumps, tanks and filters. These informal modifications create further problems for efficient network management, as I discuss in Chapters Five and Six.

In *Chapter Five, Water Underground,* I analyse the politics of water supply outside of Delhi's piped network, through decentralised 'off-grid' infrastructures of public and private sector tubewells, water tankers, and informal bottled water suppliers. Both government (tubewells) and private sector (tubewells, tankers, bottled water factories) supplies are reliant on groundwater. Either unobtrusive or mobile, these decentralised infrastructures are socially embedded in local structures of land ownership and political dominance. These decentralised supply modes have greater room for discretion from key individuals than piped network supply. Consequently, these modes are also more susceptible to diversion and capture, and present more opportunities for patronage, bias and rent-seeking than network supply. This makes them hard to reform. These modes of water supply also vary considerably from one another, having different topologies and temporalities, as well as different political and economic possibilities. The informal capture of tankers and tubewells is not a consequence of informality as state-led deregulation but lack of state capacity or political will to regulate or institute long-term improvements. The differences between water supply modes highlight the varieties of informality within water supply, as well as the

similarities and contrasts with other empirical areas, such as land and labour, which many scholars theorising informality draw on.

Chapter Six, Models and Mud analyses a PPP for urban water supply in Delhi ('the Project') as an additional layer of urban water governance. While earlier water privatisation projects 'cherry picked' the most profitable zones for revenue (Bakker, 2010), the Delhi PPP zone studied is a deliberately diverse mix of areas, including unplanned as well as very wealthy areas, as a 'test' for the operator from the government. I argue that the complexity of India's urban social hydrologies has been underestimated by this initiative, partly due to insufficient pre-contract due diligence from the multinational partner. The key project objective of continuous (24/7) water has been technically and socially challenging, and was scaled back after consumer complaints, highlighting the inertia of established systems even within wealthy and planned neighbourhoods. My research highlights the continued importance of groundwater, even within a zone of private sector efficiency. While for the city as a whole groundwater use mitigates some of the public dissatisfaction associated with network *in*efficiency, within the PPP zone it reduces the frictions produced by *greater* network efficiency. For example, consumers in unauthorised neighbourhoods (mainly low income and minority households) who refuse to accept water meters will not be supplied piped water and be left reliant on groundwater. However, as there is insufficient bulk piped water available for the project, leaving some households reliant on groundwater will be a necessary factor in the overall arrangements.

In *Chapter Seven, Conclusions* I make conclusions and suggestions for future work. My work suggests that informality in water supply functions in a range of ways which are best discussed by reference to the specifics, e.g. meter reading issues, government tubewells or illegal connections. The high level of informality in these different infrastructures demonstrates the coexistence of a submerged 'technopolitics', operating through more bureaucratic and technical modes of governance, with both overt and covert uses of discretion, personalisation and force. In addition, my findings indicate that the need for transparency and accountability of non-network water sources is an important dimension of improving water access in urban areas where the public network supply is limited. They also suggest that extension of the formal network is preferable to decentralised solutions.

Urban groundwater in Delhi is a very low quality water source and the aquifer degradation increases the importance of finding alternatives. Lastly, the effects of private sector involvement in operations and maintenance are dependent on contract, regulation and politics. Thus PPPs are not *necessarily* anti-poor and can be a means of increasing service efficiency, *provided governmental oversight and regulation are rigorous and well informed*. While this appears to be the case for the Delhi PPP project studied, it may well be difficult to replicate elsewhere.

I close by suggesting three directions for future research projects arising from this work. First, further analysis of new models of urban governance in India through research into the effects of new urban policies (Smart Cities and AMRUT) and their emphasis on private sector participation, on urban water availability and governance. Second, research into progressive public sector water reforms such as those led by the AAP in Delhi which have made strong use of inputs from well-informed water sector professionals and campaigners. Many of these changes were only beginning during my initial fieldwork. Outside of Delhi, state-led reforms of urban water supply have also been taking place in Orissa and Maharashtra and appear to be progressive changes to the existing system, rather than grafting in enclaves of private expertise. Lastly, as noted above, a changing climate will severely impact life in south Asia, particularly in relation to water use. Understandings of the relationships between urbanisation, water governance and reform in a region that supports around a fifth of the world's population are important now, and will become increasingly urgent over time.

CHAPTER 2. LITERATURE

This chapter outlines the bodies of literature that my study draws on and contributes to. Conceptually, I am influenced by research on urban informality, infrastructures, neoliberalisation and the post-colonial state. Empirically, I build on work on water reforms, particularly in India and actually existing water supply arrangements. This chapter contains four sections: informality; water infrastructures; water governance reforms; urban water in India.

INFORMALITY

The tension between reason (singular) and its others has been a long running theme in social science. Much work has analysed a tendency towards uncritical imposition of 'rational' models has been observed among modernisers, including colonial official and development workers (Blomley, 2003, 2008; Ferguson, 1994; Mitchell, 2002; Mosse, 2004; Scott, 1998). At the same time, a celebration of informality and the 'anti-plan' has been criticised for political and ethical homogenisation and projection (Bayat, 2000; Benjamin, 2008; Björkman, 2015; Gilbert, 2007a; Jones, 2011; Ranganathan, 2014b).

One focal point for an unreconstructed opposition between rational knowledge and its outside has been formal and informal activity. Informality has become a well-used, if under-analysed, trope in Geography and Urban Studies (Bayat, 1997). 'Mainstream urban studies literature' has often posited 'the informal' as a convenient 'catch-all category', 'in opposition to a well-defined 'formal'' (Burt & Ray, 2014, p. 108). The Oxford English Dictionary states that 'informal', in our context, refers to 'unofficial' behaviours[8]. Official, in turn, gives 'relating to' or 'employed by' an authority or public body and its activities and responsibilities'[9]. 'Informal' as used in relation to an economy, suggests an area of economic activity which does not follow state regulation (Harriss-White 2003, Kanbur 2009,

[8] https://en.oxforddictionaries.com/definition/informal
[9] https://en.oxforddictionaries.com/definition/official

Meagher 2010). Consequently, an informal labour force may still be highly disciplined, without the term losing purchase (cf McFarlane, 2012). Informal economic activities may not encounter state regulation (as in housework) or exploit its weaknesses (as in corporate tax avoidance). Extending this use to governance, we then have a structure of decision making which is 'outside of' or 'exploiting' official norms. Thus the use of religious concepts or social affiliations to make decisions within an explicitly secular, bureaucratic organisation could be said to be informal in this sense (see e.g. Brass, 1997).

Early modernist arguments saw the informal economy as a residue of the rural or traditional destined for incorporation into the formal economy with economic growth. Legalists, such as De Soto, would see the informal economy as caused by excessive state controls of the economy (Gilbert, 2002; Mitchell, 2005, 2008; Soto, 2003). Structuralists on the other hand would see the informal economy as a necessary accompaniment of the 'modern' capitalist economy (Portes, Castells, & Benton, 1989). This parallels the understanding of imperialism which suggests that capitalist production relies on incorporating value from other areas and sectors (Harvey 2004; Luxemburg 2001). For example, Kalyani Sanyal suggests that in India capitalist production co-exists alongside other 'uncapitalist' forms of production (Sanyal, 2014), while Sharan argues that India has a great simultaneity of historical elements (Sharan, 2014).

Informal, as a term, has now spread promiscuously to encompass informal economies more generally (not just labour); informal housing, informal urbanism, informal politics (Bayat 1997, 2000), before becoming a noun, 'informality'. Reviews of the literature describe 'informality' as used in four ways: in reference to space (most typically the 'the slum'), labour or a sector of the economy ('informal vendors'), governance (a deregulated economy), and the negotiation of value (contested and performative) (McFarlane & Waibel, 2012; Roy & AlSayyad, 2004). Michelle Kooy gives an alternate list of partial definitions, suggesting that informality is a form of practice rather than a) location b) level of development c) type of technology (e.g. decentralised) or d) form of regulation (state-sanctioned). She makes visible the ways state and development actors themselves engage in informal processes and the development of formal infrastructures also develops informal

processes through government sanctions and definitions, zones of exclusion, contestation and redefinition of subjects (Kooy, 2014)

In my use in the thesis 'informal' water represents any method of water access that is not from 'by the book' Delhi Jal Board (DJB) or their subsidiary Public-Private Partnerships (PPPs) (billed and recorded by DJB/PPP and paid for the by the consumer according to correct use and current tariff levels). Under this definition self-provision from wells would be 'informal' although not necessarily illegal. It would be illegal if the wells were dug after 2007 and not registered with the DJB. Even if the wells were registered, it was also be illegal if the groundwater was being sold commercially. Similarly using river water or rain water for household purposes is not illegal, but not part of the formal system either, so can be considered informal supply although it does not deviate from or exploit any rule or norm. The term 'alternatives' is a more neutral indication of water supply modes which avoids the normative associations of 'informality'. To be clear, illegality is a narrower category than informality. Actions are illegal if they are counter to legal norms. Actions are informal with respect to many kinds of norms.

Unfortunately, being defined in the negative, informality and related concepts run the risk of being used as 'undifferentiated' 'residual categories' (Star & Bowker, 2007). As Ananya Roy argues, 'the organizing divide is not so much between formality and informality as the differentiation that exists within informality—that which marks off different types of informal accumulation and informal politics' (Roy & AlSayyad, 2004, pp. 13–14). More sophisticated work in this vein gets beyond the general label with more specific analysis of the phenomenon in question (an excellent example is Gandhi, 2012). In my case, rather than 'informal water', it is more helpful to discuss the dynamics of private tankers and public tubewells, for example.

As I will not be able to be more specific before analysing my empirical data, a provisional definition seems appropriate. Guha-Khasnobis, Kanbur and Ostrom acknowledge arguments that the concept of an informal sector of the economy suffered from "misplaced dualism, misplaced isolation and confusion". They also accept that 'informal' is a term 'too

well ingrained in the academic and policy discourse' 'to be suppressed', and suggest two dimensions of informality:

> '[1] the extent to which [something] interacts with, or comes into the net of, the structures of *official governance* at the national or local levels;
> [2] the extent to which an activity and the interactions among its constituent individuals are structured according to a *predictable* framework (not necessarily one that is written down)' (Guha-Khasnobis, Kanbur, & Ostrom, 2006, pp. 4–10 my italics).

They go on to propose a critical element of the concept – informality is multi-dimensional:

> [T]he formal–informal continuum [should] apply strictly to the continuum between relatively high and relatively low levels of the reach of official governance mechanisms, *suitably specified and measured in each context*" (Guha-Khasnobis et al., 2006, p. 11 my italics).

Similar to the term 'infrastructure' as we will see below, the label 'informal' is relational and tells us very little without specification. Informal in relation to what? Law, land-use planning, building regulations, business registration, organisational procedures, norms of behaviour, etc… What, when, where and why a practice is informal is a question of definition. The concept of 'performativity', used in the studies of science and technology that illuminate much work on infrastructure, draws our attention to the productivity, and contestation of, a citational structure ('gender', 'truth', 'economics') and the imperfect materialisation of its effects (Butler, 2011; Barad, 2003; Mitchell, 2006). This understanding of informality forces us to attend to empirical processes and practices.

> I investigate knowledge incorporated in daily events and activities rather than knowledge articulated in words and images and printed on paper. I privilege practices over principles and study them ethnographically. (Mol, 2002, p. 32)

In this thesis, I research four main areas of informal practices:

- 'informal water' gained through methods which are outside the official operations of the Delhi Jal Board and their contractual partners;
- 'informal land-use', meaning built environments which do not comply with the city master plan and hence require either or both of the following arrangements

- 'informal politics', negotiated arrangements between individuals and groups operating on a case by case basis as exceptions to formal written arrangements
- 'informal roles', whose reality is constituted by its performance.

The last sense of informal behaviour, or social roles in which the reality of the role is constituted by its performance ('performativity'), will become apparent in the practices of neighbourhood intermediaries, social workers and minor politicians. The performance of political authority in India is discussed under this lens by Hansen on the model of the sovereign who acts outside of the law (Hansen, 2001, p. 227 ff., 2004, 2009; Hansen & Verkaaik, 2009). Ayona Datta also discusses the performativity of legitimacy, gender and power under this framework (Datta, 2012, p. 86 ff.).

Prior to its adoption for labour market economics, 'informal' was being used in anthropology and sociology to discuss social roles. Early examples are debates on customary law in anthropology (Gutkind 1965, Van Velsen in Gluckman 1969). Ernest Gellner in a 1963 discussion of kinship and social roles suggests a continuum of formal-to-informal roles. At the highly formalised end, supported by their formal status, there may be a substantial gap between the roles and what actually happens. Conversely, highly informalised roles rely on their 'performance' and do not have a recognisable 'reality' outside of this (Gellner 1963:244). For example, the 'street politician', broker, *dalaal*[10] or *sevak*[11] is likely to perform this role in addition to some other more stable source of income which provides a base for their other activities (Shah 2010:81). Once a previously informal role has become established, such as the *pradhan* system of local leaders in Delhi, performance may ossify and other actors may need to take on the role (see p77). Delhi itself has been described as a city of 'many forms', a trickster – *behrupriya* in Hindi – the name for traditional wedding entertainers who gate-crash celebrations in disguise, as police for example, and attempt to fool the hosts (Sarda & Shveta, 2010; Shukl, 2010). Blurring and divergence of roles, which writers on postcolonial statehood have called 'doubling', is a commonly observed phenomenon (Bhabha, 1984, p. 129; De Boeck & Plissart, 2004; Mbembe, 2001). To take an example from popular culture, in the 2003 film *Maqbool*, the

[10] *Dalal* (Hindi) a broker, tout or pimp
[11] *Sevak* (Hindi), 'server', worker – often translated to English as 'social worker'

Hindu police officers working for a mafia don make their important decisions by following astrological charts (V. Bhardwaj, 2003; for the role of police in communal riots see Ayyub, 2016; Brass, 1997; Hansen, 2001).

These informal roles and the informal politics they give rise to are important in understanding later theorisations of informality as a 'mode' of urbanisation or 'series of transactions'. A central thinker on urban informality, Ananya Roy suggests that informality is a 'mode' of urbanisation where "planning modalities can produce the "unplannable"—informality as a state of exception from the formal order of urbanization… Against the standard dichotomy of two sectors, formal and informal, we suggest that informality is not a separate sector but rather a series of transactions that connect different economies and spaces together" (Roy 2005:148-149). While I follow her use of informality as a mode of social action, as has long been common in anthropology, I suggest that Roy's argument generalises unhelpfully and imports statist Schmittian assumptions that do not hold for all forms of informality. Her reading of informality as the creation of sovereign power suggests that in cases like the Sangam Vihar tubewells, where state power is not sovereign, we are dealing instead with popular sovereignty (cf '*panni maliks*' – Hindi, owner or boss, *Chapter Five*), however I feel this stretches the concept of sovereignty too far.

I want to suggest that much work on informality, like Ananya Roy's, is derived from work on land and labour – particularly land in Roy's case (Roy, 2005). In parallel to the point made by Rose that land is taken as the model of property in law, theorisations of informality derived from land use are also based on assumptions of stasis and monopolistic use, which may not be appropriate for other contexts, such as water (Rose, 1995). Lines of thought are extrapolated from, say, land-use planning in Kolkata or architecture in Egypt, to 'urban life' in general (Roy & AlSayyad, 2004 see introduction and chapter by AlSayyad). For example, the informalities Roy describes in land-use planning in Kolkata are 'de-regulation', wilful ignorance from state agencies (Roy, 2002). Solomon Benjamin describes informal land-use in Delhi and Bengaluru as economically productive, even redistributive (Benjamin, 2004; Benjamin & Raman, 2011). As my empirical work illustrates neither of these things are generally true for informal water access and it would be a misjudgement to attempt to

construct a theory of 'urban informality' that does not recognise the specifics of place and resource.

> While we primarily deal with the sectors of housing and land, the implications of urban informality go beyond these discrete sectors […] urban informality while manifested in distinct sectors, is an organizing logic. It is a process of structuration that constitutes the rules of the game, determining the nature of transactions between individuals and institutions and within institutions. If formality operates through the fixing of value, including the mapping of spatial value, then informality operates through the constant negotiability of value and the unmapping of space (Roy & AlSayyad, 2004, pp. 13–14).

How does this 'negotiability of value' take place? There is a large literature on the 'informal politics' of patronage and negotiation which describes the mediated engagement with local state agencies that is a common mode of access to state institutions and services by weaker sections of society (for example Benjamin, 2008; P. Chatterjee, 2013b). These channels of influence may work through local politicians, local leaders of various kinds, agency staff acting outside their remit or through individual intercessions.

A subset of this research concerns 'fixers' (Berenschot, 2011; Reddy & Haragopal, 1985) or 'brokers' (I. M. Cook, 2015; Schindler, 2017; Blok, 1969) who arrange access to state agencies or resources. Kumar and Landy argue that 'corruption cannot be understood without examining socio-political practices such as patronage and brokerage that are traits of everyday Indian life, more specifically in metropolitan settings, where complex clientelistic relationships intertwine due to numerous interpersonal and intergroup networks' (G. Kumar & Landy, 2009, p. 106). This is well documented in research on urban water access (Björkman, 2015; Contractor, 2012; Cooper, 2011; Jha, Rao, & Woolcock, 2007; Ranganathan, 2014a).

Several studies describe the personalised infrastructure of mediation that facilitates these informal economies of the state, or what Hansen and Verkaaik call 'informal government' (Hansen & Verkaaik, 2009, p. 13 also see; Anjaria, 2011; Manor, 2000; Hansen, 2001). For example, Berenschot offers an illuminating picture of time spent with a municipal elected

representative in Ahmedabad, who sets up office each morning at a road side pitch where he receives queues of local residents asking him to intercede in various problems on their behalf. The most commonly presented issue, Berenschot found, was access to water (Berenschot, 2010a). Thomas Blom Hansen notes that the intercession of 'big men' is 'central' to relationships between ordinary people, authorities and formal institutions (Hansen, 2005, p. 130). 'Big men' are not only male; Sen's (2007) work with female Shiv Sena activists in Mumbai and Pune slums shows their use of judicious networking and applied violence as 'party workers' capable of delivering 'vote banks' (as well as beatings), to achieve services for themselves and their community.

> Ubiquitous networks of strongmen, brokers and fixers can be found in any neighbourhood, slum and *chawl* in Indian cities. Most of the activities of these men defy conventional distinctions between legality and illegality: they assist in getting water connections, jobs, housing, school admission, they adjudicate in disputes between neighbours, provide protection for those who are loyal and dependent upon them, etc. But some of them also service debt, extort money, beat up opponents and threaten those who defy or betray them. However morally ambiguous these men and their activities are in the eyes of local residents they are, nonetheless, the elementary units of local politics, of social and of cultural organisation. (Hansen, 2009, p. 193)

Several scholars have drawn on Hansen's performative understanding of politics and brokerage. The neologism, 'infra-power', builds on James Scott's idea of infra-politics or the politics of the marginalised (Scott, 2012). Infra-power is 'performative competence' of urban registers 'only shows itself in action and outcome and is reinvented through action' (McFarlane 2011:56) and is 'achieved through individual and/or social agency outside of the state apparatus'; in other words 'power from below' (Gupte, 2008, pp. 6–7).

> Even though infra-power refers particularly to non-state and extralegal channels of agency, the potency of infra-power is also tapped into by state (or 'legitimate') actors such as policemen […] infra-power not only competes with the authority (monopoly) of the state, but it can also collude or even have a corrosive effect on it (Gupte, 2008, p. 10)

Whatever terms we use to describe this 'power from below', understandings of 'water' in this context are likely to be articulated in a range of ways in addition to the predominant policy presentation of a purchased service. They may be seen as a right of urban citizenship,

a source of tenure security or livelihood quietly or brazenly encroached, or a concession provided as a 'paralegal' 'exception' via negotiations between residents, brokers, and the municipality (Mehta et al 2013, Ranganathan 2013, Björkman 2011, Chatterjee 2011, Bawa 2011, Benjamin 2008).

While alternative systems of water provision are informal economies, they are also political economies, connecting to both formal and informal politics. The contrasting Marxian and liberal uses 'political economy' as a) the political structure of economies and b) the economies of politics, are in this case both applicable.

> 'informal politics' might be summed up by the phrase 'politics is everywhere' … It is about forming alliances, exercising power, getting other people to do things, developing influence and protecting and advancing particular goals and interests. (Painter and Jeffrey 2009:7)

At a macro scale this strategic distributional ('pork-barrel') aspect of Indian politics has been dubbed 'patronage democracy' (Kanchan Chandra, 2007). For example, there are indications that infrastructure budgets are used to fund electoral campaigns and reward party supporters (Wilkinson, 2006). After the 1970s, the Congress system of patronage and political redistribution moved into a more fragmented and unstable (but still cliental) political society of 'demand groups' (Kohli, 2009, pp. 23–42; also Saez, 2002, pp. 43–68; Varshney, 2000; Yadav, 1999). At the community level, organisations such as Shiv Sena *shakas* (local groups) in Mumbai or Yadav caste networks in North India, also function as mechanisms for participation in urban resource allocation (P. Chatterjee, 2013b; Hansen, 2001; Harriss, 2005; Michelutti, 2008; Sen, 2007). Infrastructure capture and delivery plays an important role in this informal economy, as the following quote from Björkman (citing Michelutti 2007:641) illustrates:

> "Election-time distributions of goods, as well as particularistic benefits towards specific constituencies – infrastructural investments in roads, drains, or water pipes for instance – have generally been described … as evidence of the socially-embedded, "vernacular" character of Indian democracy." (Björkman 2013:7)

Partha Chatterjee, in a highly influential analysis of relationships with the state, posits a hard distinction between civil society relationships with the state, as imagined in normative

political theory, and the reality for 'most of the world', of contingent and contested claims, based not on liberal principles, but on instrumentality and utility for governmental and individual interests (2004, 2008, 2011). Claims made in the mode of 'political society' aim to mobilise their influence to exert exceptions to state policy. I find Chatterjee's conception of civil/political society more useful if viewed as a continuum, including a range of tactics in negotiations between state and non-state actors, rather than separate 'domains' occupied by distinct groups. For example, a poor people's organisation may employ both the 'civil' approach of rights rhetoric through petitions or formal legal channels and also the 'political' approach of the promise of member votes, or the threat of disruption. Similar ideas have been articulated by Nivedita Menon and Stuart Corbridge (Chatterjee 2011:90 – see Corbridge et al 2013 for a solid critique of Chatterjee). Asher Ghertner's work on middle class informality in Delhi provides some empirical examples (Ghertner, 2011, 2012). For my purposes, Chatterjee's idea of political society is important as a mode of political action with informal objectives; the exceptional *suspension* of rule or policy. This is different to political action with informal methods (those outside the ambit of 'politics' ordinarily understood) such as bribery, coercion, blackmail and so on, used by a wide range of actors but aiming at formal political objectives such as policy *implementation* or *change*.

These literatures broadly situate use with regards to the 'how' of my research objects – informal processes. Next we need to consider the 'what' – water infrastructures.

WATER INFRASTRUCTURES

Research in geography and anthropology on urban infrastructures has been a background to my own work (for a review see Larkin, 2013). This literature is itself influenced by work on large technical systems (Bijker, Hughes, & Pinch, 1987; Coutard, 1999) and studies of science and technology (Haraway, 1988; Latour, 1993). An interest in power and knowledge in South Asia has partly been an outcome of colonial attempts at classification, and there have been several notable works from South Asia in these fields (Prakash, 1999; Bear, 2007; Gopakumar, 2011).

Work on large technical systems attempts to understand socio-technical development and change in infrastructures such as roads, sewers and water supply (Geels, 2007; Geels & Kemp, 2007; Marie Llorente, 2004). A large influence from this stream of work is an emphasis on the mutual constitution of technology and society and the specific case-by-case interactions that preclude generalisation (Bijker et al., 1987; Latour, 1988; Winner, 1986). This may seem at odds with the conception of reforms as legibility and informality as opaque, however the outcomes of reform initiatives in close up appear more complex, nuanced and variable than some macro accounts would suggest. A conception of reforms as contingent and provisional, even fragile, assemblages also borrows from this literature, as well as related work in the study of development (Ferguson, 1994; Latour, 2005, p. 245; Mitchell, 2005; Tsing, 2005). A related point of interest is consideration of the role of information flows in rendering projects of all kinds possible, and the infrastructures required for these (Hull, 2012; Latour & Hermant, 2004).

These types of work also call for refocussing on material characteristics, and components of networks that might easily be overlooked, such as the famous examples of hammers, door-openers and bridges (de Laet & Mol, 2000; Latour & Hermant, 2004). Katherine Furlong argues that there has been less attention given to small technologies within science and technology studies (STS) (K. Furlong, 2011). Water meters are something of an exception and are better represented (Loftus, 2006; Schnitzler, 2008). However water tanker trucks, tubewells, pumps and filters as discreet and sometimes mobile infrastructural technologies bring different dynamics into play and allow research from a different angle to the predominant focus on large-scale government run piped networks (Coelho, Karen, 2004; Gopakumar, 2011; Walters, 2013). The material qualities of water have been emphasised in several recent studies, and I will return to this in more detail later (N. Anand, 2017; Björkman, 2015).

Infrastructure has encapsulated growing interests in mobility and technology from researchers far beyond the dry realms of public services and other ‘boring things’ (Star, 1999). However, over-enthusiastic and provocative uses of the term lead to confusion. Rather like informality, infrastructures appear to be everywhere, and the term becomes unhelpful (e.g. McFarlane & Vasudevan, 2013). Guarding against this, there are two ways in

which I am not using infrastructure. First, sociologist Michael Mann coins the concept of 'infrastructural power' (against 'despotic power') to describe the power of liberal democracies to influence civil society. In Foucauldian language, we could understand this as governmentality (against sovereign power). I do not use the term in this sense. The similar concept of 'infra-power' used by Hansen, McFarlane and Jaideep Gupte is in fact derived from James Scott's 'infra-politics' (mentioned on page 33 above), or politics from below (Mann, 2008; Hansen & Verkaaik, 2009; Gupte, 2008; McFarlane, 2011; Scott, 1987). Second, both Simone and de Boeck make valid points in their descriptions of 'people as infrastructure' and the 'body as infrastructure' (Simone, 2004; De Boeck & Plissart, 2004). While the action of intermediaries is important in my work also, I prefer to support Simone's argument without accepting his language. Here, I generally use 'infrastructure' as commonly understood to refer to material non-human things like pipes and trucks. While people, social relations, money, language etc *can* be considered infrastructures, I don't find this increasingly figurative use analytically helpful.

A related conception of infrastructures as 'background', 'ready-to-hand', or 'black boxes' (e.g. Graham, 2010; Kaika, 2005; Heidegger, 1962), can be clarified by adopting Susan Leigh Star's understanding of infrastructure as a relational concept.

> Good infrastructure is by definition invisible, part of the background for other kinds of work. It is ready to hand […] However, in light of a deeper analysis of infrastructure, and especially to understand large-scale technical systems in the making, or to examine the situations of those who are not served by a particular infrastructure this definition is both too shallow and too absolute […] One person's infrastructure is another's brick wall, or in some cases, one person's brick wall is another's object of demolition. (Star, 2002, p. 116)
>
> [I]nfrastructure is a fundamentally relational concept. [Something] becomes infrastructure in relation to organised practices. Within a given cultural context, the cook considers the water system a piece of working infrastructure integral to making dinner; for the city planner, it becomes a variable in a complex equation. Thus we ask, *when—not what—is an infrastructure* (Star & Ruhleder, 1996, p. 112, my italics)

Taking the concept of temporalities and topologies of infrastructure further we can think of informal infrastructures as performative (existing only in process) and relationally creating various spaces and times, similar to the consideration of informality (informal roles) and

governance (Mitchell's state effect) above (Mol & Law, 1994; Ghertner, 2017; Allen, 2011; P. Harvey, 2012). Performativity is useful to think with here for both infrastructure and informality as a concept drawing attention to 'what things do', (or 'how they are done') not 'what they are'. It also highlights the performatively constituted separation between entities such as 'the' economy, society, government, nature, politics, engineering and so on (Butler, 2010). As my empirical chapters show, whether we are discussing infrastructures or governance, the boundaries between public and private, material and political, or technical and social are not so easily separated.

An emphasis on materiality, is the last point where infrastructure studies resonates with my empirical work. Recent as well as classic works stress the importance of material factors or 'agency' (N. Anand, 2017; Björkman, 2015; Latour, 1996; Winner, 1986). In my fieldwork it became apparent that physical and technical factors such as slope gradient, pipe diameter and valve location are all instrumental in determining the quality of water access available (Alankar, 2013).

There are several material characteristics of water, which make it more complex than other infrastructure areas (Bakker, 2005, p. 559; also Iyer, 2003, 2007; Madari, 2007). Water is essential for humans, animals, plants and the environment as a whole. As it is non-substitutable, demand is inelastic and access to water is important for public health (as well as environmental aesthetics). As a naturally occurring, and flowing, resource with uneven distribution in space and time water has a complex 'supply chain' with variation in both source and mode of acquisition. This complexity is increased as environmental features are fundamental to the hydrological system and factors of topography, geology, social geography and built environment are strongly influential. As a bulky, heavy and fluid substance, transport and storage costs are significant and water infrastructure is capital/labour intensive with large sunk costs. These strong natural monopoly features have often been advanced as arguments for a public role in water provision.

However, water does not well fit economic conceptions of a 'public good' as water use is both 'rivalrous' and exclusionary. Water's complex 'supply chain' and variety of source and

access modes helps perhaps explain debates over the extent to which water is a public, private, merit, club good or common-pool resource. Of course these properties can be modified depending on the access arrangements in place. Production and distribution can be augmented locally by boreholes, tanks or reservoirs, for example. Groundwater can be depleted (and polluted) by industrial and agricultural uses (e.g. Aiyer, 2007). Political ecology perspectives on urban water in India, particularly including the role of groundwater (Mehta et al 2013) and 'extended urbanisation' (e.g. large dams), are useful here in highlighting the political economy of water processes (L. Mehta, 2001).

The production of cheaper food supply after India's green revolution has been bankrolled by unsustainable use of this fast diminishing natural resource (T. Shah, Roy, Qureshi, & Wang, 2003). With the increasing availability of tubewell technology, groundwater use has grown exponentially in India since the 1970s leading to a looming groundwater crisis. A tubewell is constructed by drilling into the underground rock and inserting a metal pipe into the hole to tap underground water[12]. Pumps to extract the water can be attached above ground, or submersible and sunk into the pipe. Groundwater use complicates our socio-technical understandings of water networks by introducing governance / political dynamics around tubewells, tankers and water factories, operating within and outside of official regulation. For example, Dubash describes the high risk, high return potential of tubewells in crystalline aquifers because of the random distribution of water in the rock.

The economics and politics of rural groundwater use has been a rising area of research for some time (T. Shah, 2008; Sultana, 2009, 2011). Over several papers, Trevor Birkenholtz argues the need for more research on specific 'groundwater political ecologies' and 'groundwater governmentalities' (T. Birkenholtz, 2009a; T. L. Birkenholtz, 2015). Navroz Dubash describes the implications of groundwater use for agrarian change in Gujarat (Dubash, 2001). He also notes collective governance of joint financed tubewells through 'members' committees (Dubash, 2001, p. 229). In my empirical research however, I have only encountered private tubewells installed by wealthy individuals or households, not

[12] Borewells are similar structures used in hard rock formations at less depth with PVC pipes. While the term 'borewell' is commonly used, strictly speaking most of these wells in Delhi are tubewells. In this thesis the terms do not indicate a significant difference.

collectives. However, the rotating or 'serial' supply from urban tubewells mirrors descriptions of rotating rural tubewell water supply ('*waribanda*') in Gujarat, a phenomenon also described in South India by Robert Wade (T. Shah, 2008, p. 11; Wade, 1988). A key difference however, is that rural tubewell rotations are said to provide 'timely' water supply 'discipline' (Dubash, 2001, pp. 190, 218). Urban tubewell supply was frequently described to me as random and unpredictable (see Chapter Five).

Literature on urban groundwater in social science is limited. Mihir Shah's authoritative report describes urban groundwater as a 'blind spot', and virtually neglected by social science (M. Shah, 2016). Most research is from a hydrogeological, chemical or engineering perspective. Work in environmental science has started to move towards a model of 'social-hydrology' (Malghan, Kemp-Benedict, Goswami, Muddu, & Mehta, 2013; Srinivasan, Seto, Emerson, & Gorelick, 2013; Troy, Konar, Srinivasan, & Thompson, 2015), and increased recognition of governance challenges for groundwater management is leading to calls for more interdisciplinary research (Kulkarni, Shah, & Vijay Shankar, 2015). Relatedly, the majority of work on urban water focusses on piped supply from the public sector, despite this accounting for a minority of water provision in South Asia (T. Shah, 2007; UN World Water Assessment Programme, 2006). For example, Nikhil Anand mentions groundwater briefly in his work on Mumbai as providing alternative political possibilities (N. Anand, 2011, p. 557), but the topic barely gets five pages in his recent book (N. Anand, 2017). In Delhi, a site of heavy groundwater use, there are three main social science papers (Maria, 2006, 2008; Rohilla, 2012). In Chennai, Veena Srinivasan et al discuss tanker markets (Srinivasan, Gorelick, & Goulder, 2010).

> The role that groundwater as a resource plays for the urban poor remains largely unexplored. […] The extent to which urban dwellers depend on groundwater, especially those living in low-income areas, and the difficulties they face as a result, has not been a topic of sustained research; nor has it been a topic of international policy debate. (Grönwall et al., 2010)

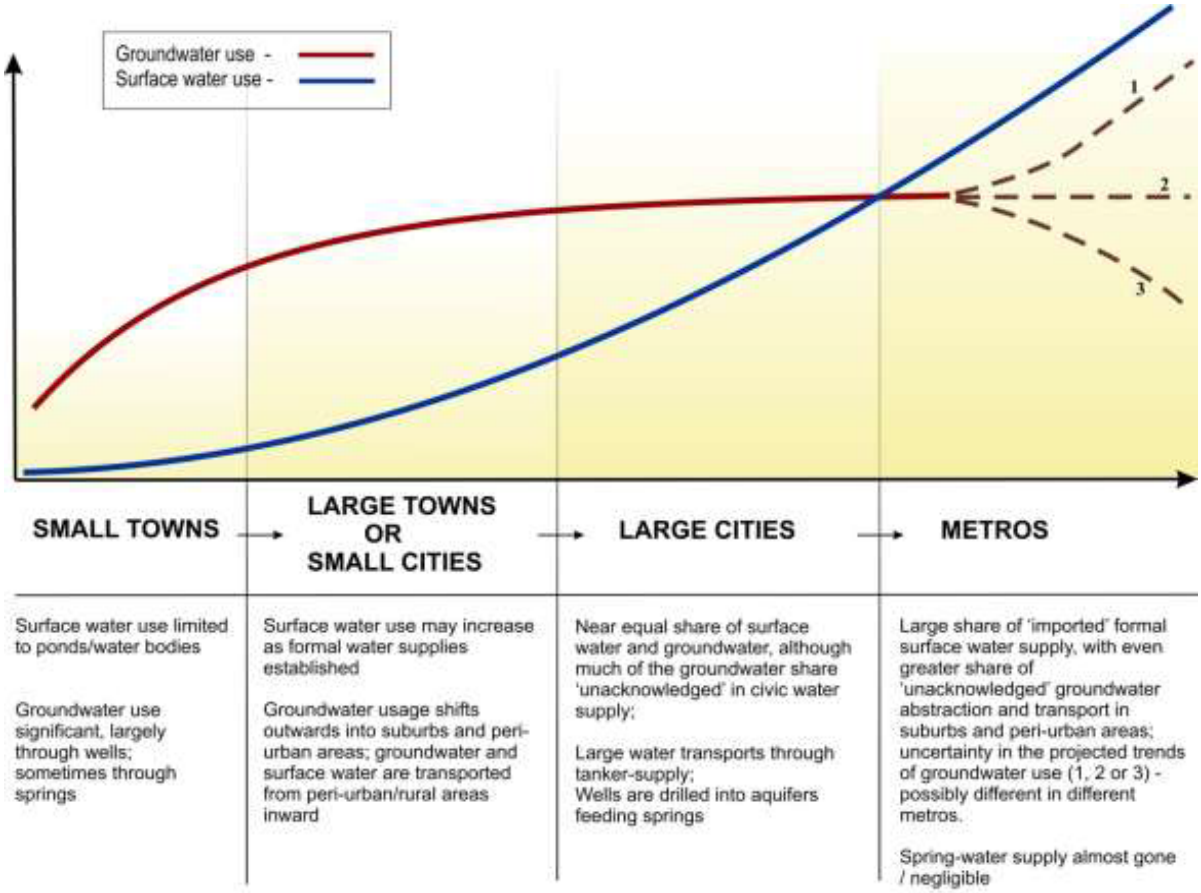
The urban use of groundwater as an alternative to public supply, little present in the social-science literature, but common in Delhi and most Indian cities, forces us to develop our understandings of urban water. Urban groundwater use is heavily class inflected, as the following table shows:

Table 1. Percentage of urban households in India using wells as primary water source 2005-6

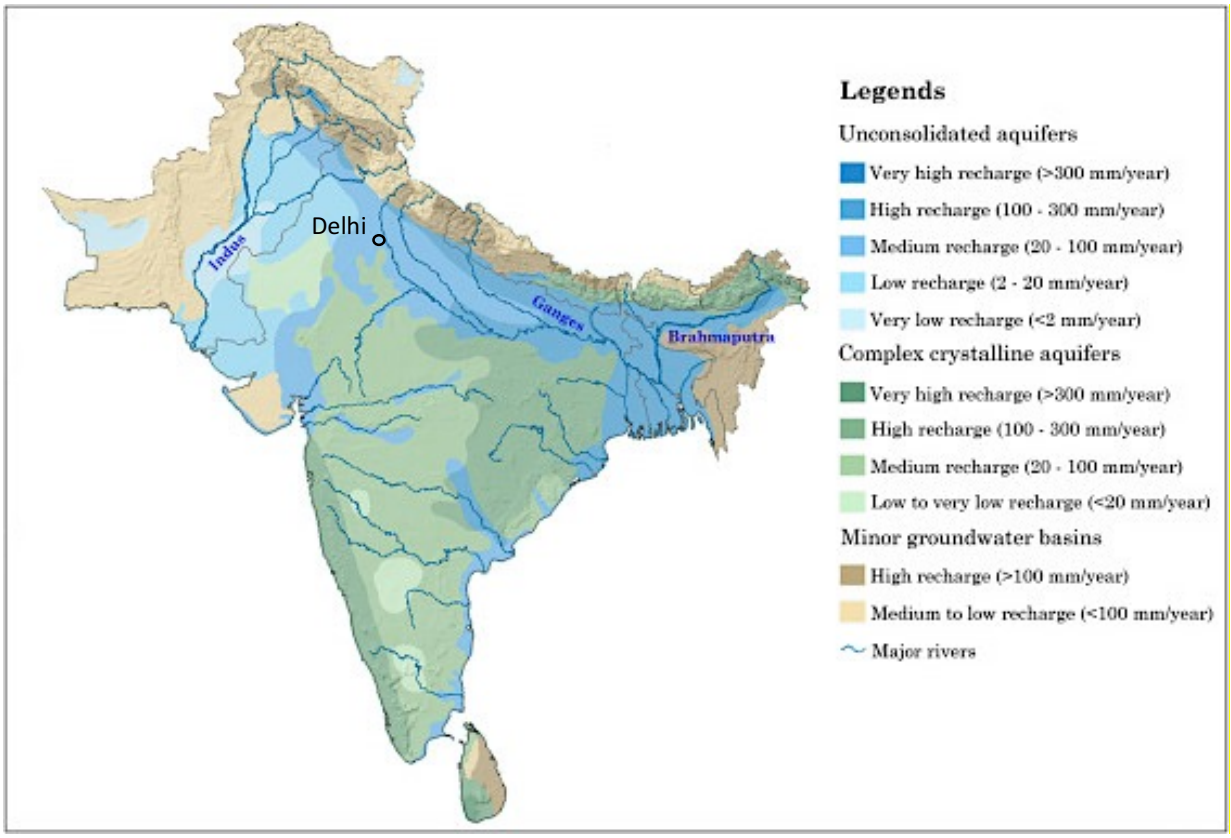
	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Percent	39	28	25	15	23

(Grönwall et al., 2010, p. 82)

Research on city size and water use shows that it is not until urban settlements reach a population of about five million that they become higher users of surface water than groundwater (Kulkarni & Shah, 2015, p. 60; M. Shah, 2016, p. 10). The vast majority of India's urban settlements are groundwater users. Delhi, as with Bengaluru (formerly Bangalore) and Chennai, is also heavily groundwater dependent. In this respect it has more in common with India's smaller cities and towns. This is also a significant difference to Mumbai, where much recent work on urban water has been situated (N. Anand, 2017; Bawa, 2011; Björkman, 2015; Button, 2016; Contractor, 2012; Cooper, 2011; Gandy, 2008; Graham, Desai, & McFarlane, 2013; McFarlane, 2011).



Generalised Trends of Surface and Groundwater Use across variously sized Urban Settlements in India (Kulkarni and Shah 2015)



Most of Delhi lies on high recharge alluvial aquifers (blue), although the medium recharge crystalline spur shown (pale green) extends into the south of the city (Mukherjee et al., 2015)

Groundwater use forces us to extend our frameworks beyond the socio-technical frames of institutions, built environment and technical systems, and to include a wider range of material factors, with different rates of change, such as: aquifer formation and location; levels, quality, and pollution sources of underground water; topography, slope, soil type; rainfall, run-off and recharge. Aquifers are closely linked to the wider ecology (Banister, 2014; Linton & Budds, 2014; Erik Swyngedouw, 2009), and consequently, industrial and household pollution levels, geology, rainfall variations and climate change affect groundwater quality and availability (Narula & Gosain, 2013).

In order not to burden the reader with a truly ugly term like 'informal politico-socio-techno-hydro-ecology', let's assume for now that 'socio-technical' processes are inherently political, operating along a formal-informal spectrum for any given parameters, and that 'hydrology' naturally includes wider ecological processes. For ease of reading then, please assume that when you see 'Delhi's water' or similar, we can understand this phrase to refer to this multi-dimensional and shifting object.

We have considered the 'how' and the 'what' for our research object, but what is the motivation? In the next section I will outline *why* informality in water infrastructures matters.

WATER GOVERNANCE REFORMS

Since the mid-1990s, the rise of market oriented neoliberal policies around the world has been mirrored by a new transnational policy network generating a global agenda on water with a prominent role for private sector involvement (Gilbert, 2007b; Goldman, 2007; L. Mehta & Madsen, 2005). Ramaswamy Iyer's description of the 'international water circuit' involved includes 'the World Bank, Asian Development Bank (ADB), United Nations (UN) agencies, the World Water Council, the Global Water Partnership and its national affiliates, the International Water Management Institute (Colombo)' (Iyer 2006:201). This international model of water management can be termed 'global water governance' (Castro, 2007b; Urueña, 2012). However, informal water supply arrangements have generally been a fairly limited part of this discussion.

There has historically been a high level of donor agreement on the case for private investment in infrastructure (Bakker, 2013a; Gilbert, 2007b; Goldman, 2007; Sohoni, 2012), despite causal links between private investment and development outcomes not being well understood (Shah and Batley 2009). Advocates argue that private sector participation in water provision brings in financial and technical resources, improves the efficiency of utilities, reduces corruption, poor governance, political interference, and leads to increased access and improved quality of water supply (Prasad, 2006; see e.g. Briscoe & Malik, 2006). Researchers suggest that pressure from international agencies and donor countries to promote private sector involvement in basic services, including water, is motivated by the search for new markets for Euro-American expertise and technology (Mehrotra & Delamonica, 2005, p. 166; also see Goldman, 2005, p. xvii ff.; Bakker, 2010). Researchers have found World Bank discourse in Delhi (V. Asthana, 2009, 2011; Kejriwal & Bhaduri, 2005) and elsewhere in India (Sangameswaran, 2006) to be market-centric and technocratic (Moretto, 2006). For example, a strongly commercial tendency in 'global water governance' has been promoted by the World Bank, such as in Maharashtra and Karnataka, where it has

been a conditional requirement of a loan from the Bank to the State governments (Bakker, 2013a; Gilbert, 2007b; Sohoni, 2012; on Karnataka see Goldman, 2007; Ranganathan, 2014b; Baindur & Kamath, 2009; on Maharashtra see Sangameswaran, 2009, 2014; World Bank, 2012). The model is based on commercialisation of water supply, through creating financially viable institutions through New Public Management in order to secure private-sector investment and expertise. This overly prescriptive policy agenda to the neglect of local context can result in both deleterious outcomes for low-income users and severe difficulties for project implementation.

The majority of water users globally are currently served by the public sector or 'alternative' supply methods including self- and community-provision. Around 90% of 'formal' water and sanitation provision is public (Prasad 2006:670). In much of the world, however, the spatial and economic legacies of colonialism have made the development of universal public service provision a substantial challenge. In addition to physical and macro-economic constraints, public infrastructure in developing countries, as in the global north, is often affected by political intervention, patronage and corruption. A circular 'low-equilibrium trap' stemming from poor quality service leads to alternative arrangements thereby reducing utility revenues. Subsequent reduction in capital (or more likely, increased deficit) results in reduced operating expenditure and further declines in service quality (Prasad 2006:670). This model fits publicly managed water supply in India well. Both state and municipal utilities suffer from low service levels, below-cost pricing, low recovery levels, and vast subsidies from local and State governments.

The principle of commercial logics in urban water supply remains politically contested and private sector involvement in water has been the subject of particularly heated debate (see e.g. Araral & Wang, 2013; Bakker, 2010; Coelho, 2011). Developing in parallel with understandings of water as a commercial service has been the development of a 'minor discourse' of water as a human right (L. Mehta, Allouche, Nicol, & Walnycki, 2014; Urueña, 2012). Privatization initiatives in many countries have faced criticism on efficiency, equity and accountability grounds. Critics allege that private sector participation can exacerbate inequalities of service and may have little incentive to extend coverage to unprofitable areas (Budds & McGranahan, 2003, pp. 88–89; Castro, 2007a). Advocates of private sector

involvement in water supply have had to reassess their approach in the face of political and commercial difficulties. Very few privatisation projects to date have been successful, and the majority did not achieve what they intended (Economic and Political Weekly, 2015; Prasad, 2006, p. 682).

It seems unlikely that private sector is interested, or will be able to, address water and sanitation service challenges at scale. The level of private sector participation in water supply globally did increase during the 90s, but was primarily directed at those countries with larger populations, economies and levels of urbanisation. From the private sector's perspective, low-income countries and the poor in particular are unattractive and have high levels of risk. In order to circumvent this risk, it is argued that the private sector 'cherry picks' the better-off customers in an urban area or a less risky environment (Bakker, 2010, p. 94; E. Swyngedouw, 2006, p. 56). It may also rely on subsidies or soft loans to provide services to the poor (Prasad 2006:688). Apparently low costs may also be based on an assumption of contract renegotiation after the project is underway (P. B. Mehta, 2013). While private sector investment is declining due to a relatively low rate of return, overseas development aid is also declining, which Bakker attributes to expectations that the private sector will increase investment. Bakker argues that the development of neoliberal approaches has led to private involvement in water and sanitation becoming more spatially differentiated (Bakker, 2013a, 2013b; Ferguson, 2005; Harrison, 2001). While there has been a gradual overall increase in private sector participation in water infrastructure, there has also been a strategic retreat from less profitable regions, especially South Asia and sub-Saharan Africa (R. Shah & Batley, 2009, p. 398). China however has seen increasing numbers of projects, in comparison with which, PPP water projects in India are 'insignificant' both in terms of investment and population served (X. Wu et al., 2016). This pattern is replicated at lower scales with 'unserved' populations concentrated in rural and peri-urban areas, smaller towns, and low-income neighbourhoods where the private sector has shown little interest in investing upfront costs for limited and risky returns (Budds & McGranahan, 2003, p. 88).

As the challenges to private involvement have become increasingly clear, researchers across political positions now recognise that governance and regulation of utilities is critical in

supporting reforms to deliver social or economic benefits (Budds and McGranahan 2003:87, Bakker 2008:1893). This presence of a wider range of actors in infrastructure provision through private sector participation and international investment ('financialisation') (Torrance, 2007, 2008, 2009) means that infrastructure governance increasingly involves a more corporate and internationalised governance-beyond-the-state (Swyngedouw et al 2002, Swyngedouw 2005). The promotion of private sector involvement by international agencies also currently appears to be moving towards more realistic assessments and discussions over the most appropriate form for management and ownership of utilities.

A shift from privatisation to governance has followed the limited success of earlier privatisation initiatives. 'Governance' – a classic Third World *lack* – has a gentle ambiguity, conveniently encompassing both political influence, badly designed contracts, and vested interests, as well as operating as a code word for commercialisation. The primary sense in which 'governance' is commonly used is in academic literature refers to a networked, multi-nodal style of decision-making and action involving the combination and coordination of different actors (Rhodes 1996, Stoker 1998, Jessop 2002). A second, derivative, understanding of 'governance' is as 'good governance' a normative donor-led agenda focussing on accountability, stability, effectiveness, regulatory quality, rule of law, and control of corruption (Weiss 2000, Doornbos 2001). This sense dates from the World Bank's 1989 Report on sub-Saharan Africa, as an element of the (post-)Washington consensus on (softened) market liberalisation. Vicky Walters' research into the water reforms in Karnataka does an excellent job of illustrating the anti-democratic consequences of 'good governance' in water reforms in Karnataka (Walters, 2013). Indeed, this second sense that has been a key element of urban and water policy in India since the early 2000s (Batra 2006, Young in Kamat eds. 2013, Cullet 2007). The term 'water governance' often appears to reference this 'good governance' understanding (Cleaver & Hamada, 2010; Franks & Cleaver, 2007). Discursively, 'governance' is commonly presented normatively, as the opposite of 'politics', with the implication of a technocratic, objective and rational decision making style.

> The categories of states and markets, or public and private, and the term "governance" as a means of capturing the articulations between the two, are

> unhelpful in delineating the contours of the problem. … The term "governance," in turn, allows the fiction of apolitical negotiation to be sustained and enables development-policy experts to relegate failure to the merely technical realm. (Bakker 2010:47).

The extent to which 'governance talk', *per se*, is depoliticising, as Bakker argues, I think remains open. While some commentators (for example Rhodes 1996) appear over-optimistic in their assessment of the transformative power of restructure relationships, others are more cautious (for example Davies 2002). In my use the term "governance" is not a normative concept, merely a reflection of the density and complexity of relationships in urban management and services beyond 'the state' (Hansen, 2009; Erik Swyngedouw, 2005). Kaviraj makes similar use of the word to refer to the interactions of multiple political actors and 'short-term nexus of interests' (Kaviraj, 2012, p. 110). Another response to claims of depoliticisation aimed at the use of the term 'governance' is the moderate optimism from Mollinga et al, who suggest that it provides a 'wedge' to lever discussion of water politics onto, and higher up, the mainstream policy agenda. Acknowledging arguments about the depoliticisation of development made by Ferguson and Scott, Mollinga suggests that use of 'governance' may be a 'step forward' as it enables consideration of 'the *kind* of politics that is found in, or desirable for, water resources management' (Ferguson, 1994; Scott, 1998; P. Mollinga, 2008, pp. 8–9).

The question of how 'actually existing' neoliberalisation processes engage with the local context has been the theme of much work in urban geography (Brenner, 2004; Brenner & Theodore, 2002; D. Harvey, 2005; Jamie Peck, Theodore, & Brenner, 2013). A related body of research considers how policy ideas travel and mutate across sites and scales (McCann, 2011; J. Peck, 2011; Jamie Peck & Theodore, 2010). I have found work on individuals, such as engineers and consultants, as vectors of policy ideas particularly interesting (Larner & Laurie, 2010; Prince, 2012). For example, Vicky Walters' study of water reform in Karnataka, mentioned above, highlights the technocratic use of consultants by public officials and donors and the challenges for accountability this causes (Walters, 2013, p. 167). Private sector consultants are also 'people as infrastructure', acting analogously, but at different scales, to the brokers mentioned above.

Water governance reform recognises that privatisation is just one option, along with commercialisation of public sector organisations, 'alternative service delivery models', and a range of outsourcing and contractual approaches (Kathryn Furlong, 2012, 2015; Kathryn Furlong & Bakker, 2010). The most complete form of 'privatisation' is full divestiture in which assets, capital, risk and service management are transferred to the private sector permanently, as in the UK water sector (one of the few successful examples). However, there are a variety of contractual arrangements in which control over assets, tariffs, operations and risk are shared or divided between public and private sector parties. In the 'lightest' forms of private sector involvement, management and operations are outsourced for a short amount of time to avail of private sector efficiency, technology, and expertise. The PPP approach currently favoured in India grows out of this background (Iyer 2007:211).

In India, despite being fierce opponents at different ends of the political spectrum, both Modi's right-wing-populist Bharatiya Janata Party (BJP) at the National level and Kejriwal's progressive-populist Aam Aadmi Party (AAP) in Delhi gain populist appeal with their strong rhetorical emphasis on good governance and anti-corruption measures. In this they are part of larger pattern in India politics, identified in the early days of liberalisation by Partha Chatterjee as 'rational planning' in tension with 'irrational politics' (P. Chatterjee, 1999, 2013a). Indeed, the Indian central government urban policy has been increasingly adopting a pro-market 'good governance' agenda for several decades, in parallel with the country's wider economic liberalisation. These economic changes introduced since the late 80s have a normative appellation; 'reforms' (see Bhabha, 1984 on the colonial history of this word). A comprehensive review of this process of urban restructuring and rescaling, along the lines of Brenner's work on Europe (Brenner, 2004), remains to be written (but see Baindur & Kamath, 2009; Batra, 2006; Shatkin, 2013; Sivaramakrishnan, 2011). The promotion of PPP models and the opening of real-estate and urban development to international investment has been a central theme over the last decade. This process has taken a further turn with the ascent of the National Democratic Alliance (NDA) government in 2014 leading to a push for Smart Cities as well as basic infrastructure improvements (Datta, 2015).

In previous research I looked at India's national 'Urban Renewal Mission' (JNNURM), which aimed at creating a cadre of 'world-class cities' across India. I was curious about the gaps and transformations in policy and ideology as they moved across different sites; from international agencies and local actors to national policy and then to urban governments in different states. My findings highlighted the promise and challenges of the introduction of new technology and private sector models (and partners) into established processes of city governance. These issues continue to play a role, perhaps a greater one, in India's current Smart Cities Mission. From this research the diffusion of policy packages and ideologies (such as 'neoliberalism') across tiers of government did not look as mechanistic as some had suggested (Banerjee-Guha, 2009). Instead it began to seem much more precarious, contingent and contested, rather like Mitchell's discussion of neoliberalism (Mitchell, 2005, 2008; also see Tsing, 2005). Far from a corporate juggernaut of international origin reshaping all in its path, the Urban Renewal Mission's journey to city level resembled more a 'crumb thrown in an ant's nest' (Ferguson, 1994, p. 225). It appears, as Barbara Harriss-White has observed, that in India there is some distance between the 'World Bank state' imagined by reform projects, and the actually existing 'shadow state' with strong incentives to maintain the current situation (Harriss-White, 2003, p. 88 ff.).

Water is an important target of reform, a critical input for agriculture, industry and urbanisation, and highly emotive issue. The reform agenda mentioned above is described neatly as comprised of two contradictory and unequal tendencies, market-based 'neoliberal' approaches, and rights-based ideas (Urueña, 2012). Water was the largest sector of spending under the JNNURM and the pattern of reforms was echoed in sector specific policies, particularly the National Water Policies of 2002 and 2012 and Guidelines for Sector Reform and Successful Public–Private Partnerships (2004). Water and sanitation also formed a 'core of the approach' in the City Challenge Fund, which incentivised urban reforms prior to the JNNURM and Smart Cities Mission (Gopakumar, 2011, p. 128; Naidu, 2002, pp. 11–12). The urban governance reform components of the JNNURM have been carried forward under the National Democratic Alliance government into the AMRUT mission (Town and Country Planning Organization, 2016).

As urban development, water and land are state government mandates under India's constitution, central government can only obliquely influence them. Although in India's federal system, water is constitutionally a subject of State governments, broad outlines for a reformist approach can be given. Indian water researchers suggest that these policies include: unbundling of the 'supply chain' (source, transmission, distribution); independent ('apolitical') regulator; full cost recovery for operations and maintenance; increasing tariffs, which should be 'depoliticised'; elimination of subsidies; cut-offs for non-payment; ending and removal of public supplies (standposts, public taps); staff retrenchment to meet international norms of four staff for every thousand connections (most Indian utilities work with a ratio five or six times higher); public-private partnerships; water markets and or trade-able water rights; allocation of water to highest value use (Dwivedi, Rehmat, & Dharmadhikary, 2007, pp. 36–37). For other examples from India see (Asian Development Bank, 2011; Dwivedi, 2010; Dwivedi et al., 2007; Sangameswaran, 2006; Sangameswaran, Rozario, & Madhav, 2008).

The connotations of private sector involvement in water in the Indian context are double-edged. On the one hand, as Simanti Dasgupta has argued, following the success of the IT and Business Process Outsourcing industries, the Private Sector in India has been accompanied by associations of national pride, innovation and, particularly, good governance – in contrast to the perceived inefficiency, political bias and corruption of state agencies (Dasgupta, 2015; cf Sachdeva & Rajadhyaksha, 2003). On the other hand, talk of privatisation, especially where it involves foreign companies, taps in to (justifiable) anxieties of neocolonial exploitation of Indian resources and markets. Water, in particular, evokes strong emotions, as a substance essential for life, sacred in south Asian belief systems, and part of the triad of *jungle, jal, jameen* (forests, water and land), which serve as rallying cry for activists. Rivers in India are sacred to both Hindu and tribal people, water has a special place in Islam (Wescoat, 1995), and Dalit struggles have very often organised around access to water. An illustration of this strong cultural attachment to water provision are the free public drinking stations (*piao*s) still commonly seen across Indian cities. Consequently, 'privatisation' forms a powerful rhetorical charge against which politicians and administrators must respond. The 'PPP mode', most favoured by contemporary politicians, already responds to these concerns (cf e.g. Baindur & Kamath, 2009, p. 6). It can be

considered a 'second-wave' of neoliberalisation in water which has learnt from the failures of earlier attempts (Smith, 2004).

At the same time, high-pitched 'privatisation' rhetoric obscures the role of the local private sector in existing water supply, whether market operators supplying bottled, tanker and ground water across Indian cities, the private contractors who already perform much of the maintenance, construction, development and consultancy works for municipal water services, or the 'privatisation' of public positions through discretionary and highly personalised ways of working (Ahlers, Schwartz, & Güida, 2013; A. Asthana, 2008; Berenschot, 2010a; M. Llorente & Zerah, 2003; National Institute of Urban Affairs, 2002; Ranganathan, 2014a). As Harriss-White observes this is true of both the opponents and advocates of reform:

> Contemporary calls for the radical privatisation of the State […] ignore the effective radical privatisation, informalisation and now mafianisation that south Asian States have been undergoing for much longer than the era of liberalisation of the 1990s (Harriss-White, 2003, p. 101).

Harriss-White notes the trend towards 'information-intensive' state practices, a tendency that has become only more apparent since her book was published (Harriss-White, 2003, p. 101). There are possibilities for increased accountability and transparency with higher capacity to process information; dependent on the circumstances of local politics and corrupt practices (Bussell, 2012; Masiero, 2015). However, information and communications technology may be ignored or confined to an isolated element of a process thereby rendered ineffectual, perhaps more often than it is idolised as a panacea or well-integrated (Heeks, 1998; Heeks & Mathisen, 2012). In a 2003 survey, 85% of Indian officials judged the e-governance processes they had been involved with to have been 'total' or 'partial failures' (Heeks, 2003).

Just as the ability of informal practices to maintain themselves depends on flows of information (Scott, 1998), water reforms too are as much about assembling and maintaining flows of information as they are flows of water (K. Furlong, 2011; Monstadt, 2009). How much water is delivered to the Demand Management Area from which Water Treatment

Plants? How many connections exist? How much water is billed? How many of these bills are collected? Creating systems to answering these questions is essential for water managers seeking to implement financial viability. Various technologies are fundamental to this process (cf Latour & Hermant, 2004). In addition to these prosaic circuits of information concerning material non-human actors (such as taps or water meters), there is a wider sense in which reform is also about constructing flows of information which channel human thought and behaviour. In this context 'water conservation', 'municipal water as commodity' and 'social legitimacy of the private suppliers' are areas in which reforms may need to shape consumer thought and behaviour (Latour, 2005, p. 226; also see Mitchell, 2005, 2008). We can also consider 'good governance', 'democracy', or 'nationalism' in this way (e.g. P. Chatterjee, 1993). In a postcolonial context, such as India, the limited productivity of the debate over public or private solutions is heightened by the tenuous translation of concepts – such as 'nationalism' (Chakrabarty 2000).

While from an external perspective the variation of water supply arrangements in contemporary Delhi appears as a symbol of breakdown and failure (cf Gandy, 2008), some understanding of the historical context reveals continuity with pre-existing local practices. Work on the histories of water use in India highlights the specificity of the dominant international understandings of 'public' and 'private' water. David Mosse's work on the political role of water in southern India's Hindu kingdoms is a strong example (Mosse, 2005). The histories of water infrastructure in north India are quite different, but similarly call into question a simple public-private binary. I suggest that the presence of multiple overlapping water supply arrangements, and 'waters' (Hamlin, 2000) instead suggests the resilience of historically embedded practices of water supply (cf Chakrabarty, 2009). Most studies of water in India, if they consider history, start at the colonial period; perhaps because Mumbai, a colonial city, is a frequently chosen site. This leads to an over-emphasis on the 'limited liberalism' of colonial infrastructure provision and a lack of recognition of the structures of pre-existing water supply practices (N. Anand, 2017; Björkman, 2015; Gandy, 2008). However, the range of water supply modes evident in historical accounts demonstrate that splintered urban infrastructures are not only a product of neoliberalism (Graham & Marvin, 2001) or colonialism (Kooy & Bakker, 2015) but in many places are part of longer, layered, histories (Alsayyad & Roy, 2006; cf Mann, 2008).

The specific political histories (and geographies) of the Indian subcontinent do not fit well with North Atlantic conceptions of state sovereignty (Legg 2007, Mosse 2003). Consequently, the application of 'international' water governance models drawn from the experience of the global North runs against the grain of local understandings. The appropriateness of their use could be called into question in the same way as the concepts of 'civil society' and 'democracy' (Lewis 2002, Kaviraj et al 2001, Michelutti 2007, Corbridge et al 2012). As Sudipta Kaviraj and Partha Chatterjee (among others) have argued, both civil society and the state took on quite different characters in South Asia from their European origins (P. Chatterjee, 2011; Kaviraj, 2010). Anderson gives a compelling recent account of four central contradictions of India's national ideology (Anderson, 2013). In India, it is argued that rather than the state being 'governmentalised' by civil society, first the Colonial, then Nehruvian state took on the task of governmentalizing society (e.g. making it into rational, individual, modern actors, responsible for their own civic conduct and operating along bureaucratic lines). At the same time, society appears to have influenced state actors away from putative bureaucratic impartiality towards shifting arrangements of differentiated responsiveness and bias. The complexity of 'local' societies led administrators to the instrumental government of population groups (Hindu, Muslim, Punjabi, peasants, etc) *as* groups, for whom the individual rights of citizenships were always already deferred (P. Chatterjee, 2013b). In North India, these dynamics relate to the co-optation, and later occupation, of Mughal state structures by the East India Company and British Raj, and their selective treatment of different population groups, most obviously defined by race, religion and caste (Dirks, 2011; Spear, 1990). In sum, rather than the state influencing forms of informality in India the widespread presence and power of informal practices is argued to have led to an 'informalisation of the state', or '*jughee / jugaad* state' – Kaviraj's 'feet of vernacular clay' (Chattaraj, 2012; also see Jeffrey, 2010, p. 163). Political theorists in India, also refer to India local state structures as 'porous' (Benjamin), 'vernacular' (Kaviraj), 'blurred' (Gupta), 'medieval' (Roy), 'leaky' (Coelho), 'embedded' (Björkman) and so on. In this context, the introduction of electoral democracy has led to strong attempts at selective redistribution compromised by limited resources and political strategy

Attempts to bring private sector expertise and models from developed countries to the global south are undertaking a very different project from the transition from public sector to private sector water supply in the West. The commercialisation of water was not simple even in England and Canada (Bakker, 2005; Kathryn Furlong, 2015). In a country like India, network provision is very far from complete, and the introduction of the private sector is therefore faced with an entirely different set of problems. The 'universal network model' of provision, an infrastructural equivalent of the Weberian bureaucratic state, based on equal citizenship, never existed and the post-colonial developmental state was not only in a radically inferior economic position to the welfare states of Western Europe but was undergoing a very different political transformation (Corbridge & Harriss, 2000; Graham & Marvin, 2001; Kaviraj, 2010, p. 212).

Informality is in tension with reforms in India, and Delhi, at a range of scales, from city to household level. At the same time, informality and reform are not binary oppositions. Tim Mitchell has discussed the ways that rationalisation reforms create knowledge in interactions with their objects and highlights the 'knowledge transfer' (or 'epistemic violence') involved where dispersed local understandings, opaque or invisible to outsiders, are replaced with more portable knowledge transparent to wider networks of readers (such as colonial officials, development agencies, international credit markets, financial investors and so on) (Mitchell, 2002). We can take this argument further with the idea that the reification and separation of 'state', 'society' and 'economy' is a fiction central to the idea of 'free markets' and liberalisation reforms:

> The apparent boundary of the state does not mark the limit of the processes of regulation. It is itself a product of those processes. […] The state is no longer to be taken as an actor with the coherence, agency, and autonomy this term presumes. The multiple arrangements that produce the apparent separateness of the state create effects of agency and partial autonomy, with concrete consequences. Yet such agency will always be contingent on the production of difference – those practices that create the apparent boundary between state and society. (Mitchell, 2006, pp. 175–176)

Where reforms such as Cities Challenge, JNNURM, Smart Cities, AMRUT, and individual private sector involvement initiatives, attempt to increase legibility, entrepreneurialism or investment capacity, we have then a tension between 'modernisation' and 'informality'. Or

in Chatterjee's terms (above) 'rationalisation' and 'politics'. Lisa Weinstein writes that research on economic restructuring in India has neglected informal governance, while at the same time work on informal governance has neglected economic restructuring (Weinstein, 2008). Indeed, despite some engagement with 'informal water' from policy organisations, work on the relationships of these alternative arrangements to water supply reform programmes is still growing.

Research indicates that the informal political economy and governance of infrastructure strongly influenced JNNURM implementation. For urban governments with weaker domestic and external political networks, opposition to reforms unpopular with residents and entrenched interests may present a serious obstacle (Birkinshaw, 2013, 2016). The difficulties in doing water and energy audits in Indian cities point to this issue (N. Anand, 2015; Björkman, 2011). There is some support in the literature for thinking that these dynamics also apply to water interventions, although the relationships between informal water supply and reforms have not been heavily studied.

Zérah's study in Pune, suggests that informal supply arrangements can present an obstacle to reforms (M.-H. Zérah, 2000). In work on a PPP project in Karnataka, researchers found that informal water use, such as storage and non-payment, continued in the system despite reforms, and were not reduced by them (Burt & Ray, 2014). Researchers have considered 'neoliberal' water reform projects in Mumbai, Pune, Maharashtra as a whole, Bengaluru and Karnataka, Chennai and Jaipur (T. Birkenholtz, 2010; Björkman, 2011; Gopakumar, 2011, 2014; Kamath, Baindur, & Ranganathan, 2009; Ranganathan, 2014b; Sangameswaran, 2006, 2009; Sangameswaran et al., 2008; Walters, 2013; M.-H. Zérah, 2000). There is, however, very limited work on pipe network rehabilitation projects (which I study in Chapter Seven) outside of the Berkeley research project in Hubli-Dharwad, Karnataka (Burt & Ray, 2014; Ercumen et al., 2015) and studies by the ADB (Asian Development Bank & Lee Kuan Yew School of Public Policy, 2010).

Both Nikhil Anand and Lisa Björkman consider private sector involvement in Mumbai (Björkman, 2011; Anand, 2015). Björkman's work places some of the dysfunction in Mumbai's water system on an inappropriate application of norms taken from developed

world cities to Mumbai. She suggests that desire for privatisation has led to underinvestment in municipal management. However, her account also highlights the relative power of the Mumbai Water Department regarding the proposed reforms by the World Bank. To the extent that in her account the Water Department was able to take the money for the project without undue tension to deliver the results that the Bank was looking for. Anand describes the impossibility of producing accurate data on Mumbai's water system, despite the frequently with which numerical measurements are given by his respondents. In both these accounts, the privatisation project failed to start during the fieldwork period (but work has now begun under the same multinational that I study in Chapter Seven), consequently we have in these accounts sensitive explorations of the effects of proposed privatisation on the government water body.

An important contribution to the literature on water reforms in South India is Govind Gopakumar's work on Bangalore, Chennai and Kochi. The Greater Bangalore Water Supply project in particular has been an instructive a case study of market-oriented reforms and the involvement of international agencies (World Bank, ADB, USAID). Research found 'serious disconnects between the [water reform] model and technical, social and economic realities on the ground' (Kamath, Baindur, & Ranganathan, 2009, p. 61). For example, despite collecting beneficiary contributions from peri-urban areas, the project struggled to provide water to (potential) consumers (Ranganathan, 2014b). Researchers have also highlighted the projects initiative to replace free of cost standpipes from slums with chargeable water connections (Walters, 2013, p. 107 ff. Gopakumar, 2014). Gopakumar observed the integration of informal areas in the Bengaluru reform project through NGO service provision. He describes this as an a 'territorialisation of state power', 'spatial fix' and attempt to create archipelagos of good service (Gopakumar, 2014). This integration of informal areas of the city with formal networks strongly resembles in infrastructure, the influential approach to informal land tenure advocated by De Soto (Gilbert 2002, Mitchell 2005). Research by World Bank staff on water privatisation and non-payment in Manila also observes that the concessionaires had effectively outsourced operations and management as well as billing and collection for unserved areas to local entrepreneurs or CBOs. This is described in an influential early paper and more recent study (Solo, 1999; Cheng, 2013). Cheng notes that the informal networks have effectively been included within the formal

system and may also serve to extend it, although she does note some concerns around the governance and affordability of these 'micro-networks'. This is a similar approach to the Delhi water board's incorporation of informal areas through intermediary groups reported by Kacker and Joshi (2012). These blurred edges of the city's network are the subject of my research discussed in Chapter Six.

There has been much discussion of the privatisation in Delhi, with some good short academic papers (Kejriwal & Bhaduri, 2005; Sampat & Koonan, 2012). Asthana focusses on Delhi's proposed, and at the time, failed, privatisation and a standalone water treatment plant, but not network infrastructure or at neighbourhood scale (V. Asthana, 2009). I adopt a different approach by investigating the material realities of reforms at a neighbourhood level, and their relationships with informal water supply (Chapters Six and Seven).

URBAN WATER IN INDIA

Urban water has attracted increasing interest for geographers and anthropologists over the last decade, coincident with the 'infrastructural turn' in the disciplines (Stephen Graham, 2010, p. 10; Anand, Bach, Elyachar, & Mains, 2011). Graham and Marvin's ambitious synthetic attempt to situate urban infrastructures as sites of neoliberal accumulation set the tone for subsequent debates (Stephen Graham & Marvin, 2001; Coutard, 2008). The topic is not new, the relationship between urban flows, money and power has been discussed since the late 1960's at least (Lefebvre, 2011; Castells, 1977; Foucault, 2007). On water, specifically, Swyngedouw and Kaika made important early contributions to our understandings of the politics of urban water by drawing on science studies and large technical systems (Swyngedouw, 2004; Kaika, 2005). Matthew Gandy's work on urban metabolism again draws on science studies and political ecology (Gandy, 2003, 2005).

Work in on urban water in South Asia is mainly concentrated in India, and mainly on public urban water networks. Research on urban water provision in India describes partial, biased, corrupt, inefficient, politically instrumentalised services. Informal water governance in urban India is a small (but growing) area of work and the subject of only a few ethnographic papers (Cooper 2011, Anand 2011, 2012, Ranganathan 2013, 2014, Björkman 2011, 2014,

forthcoming) and mentioned briefly in others (Berenschot 2010, 2011a, 2011b, Gandy 2008). Indeed, while early works do exist (Coelho, Karen, 2004; Marie-Hélène Zérah, 2000b), the major monographs that exist on urban water governance (Anand, 2017; Björkman, 2015) and urban water reforms (V. Asthana, 2009; Gopakumar, 2011; Sangameswaran, 2014; Walters, 2013) have largely been published in recent years.

An early, comprehensive and still instructive study of Delhi's water supply by Marie-Hélène Zérah, *Water: Unreliable Supply in Delhi*, highlights the gaps in official statistics by illustrating the difference between connection to the water network and adequate supply. Zérah's survey found that around 50% of the Delhi population do not have reliable water supply, and must supplement with alternative sources. This is often despite connection to the piped network as the water from the public utility is available at unpredictable or inconvenient times, at very low pressure, in low quantity or not of sufficient quality. Zérah found that the average length of supply was two hours. In the south and west of the city 30% of households used ground water via hand pumps or tubewells and 40% of households collected water from other sources 'at least occasionally' (West 48%, South 26.7%). Zérah's work also found that a large number of households used supplementary sources due to the unreliability of government supply. Note that despite better service levels residents in South Delhi were more likely to complain (South 30.8%, compare 7.2% in West, 8% in the North and East) (Zérah 2000:300). Of the seven water reform areas in Delhi, two of the most well publicised, Vasant Vihar (upper middle class) and Malviya Nagar (mixed income), have active RWAs. Zérah's work in Delhi give an indication of the scale of alternative uses and suggest that alternative uses are a response to inadequate supply quality (reliability, timings, pressure and quality) (Marie-Hélène Zérah, 2000b). She makes an important advance in moving beyond simple binary connection metrics to highlight the quality dimension of urban infrastructures (Marie-Hélène Zérah, 1998). There is however potential to build on this work with research on alternative access arrangements, their 'social regulation', differences across areas, and relationships to reforms in formal supply.

More recent work by Yaffa Truelove extends Ayona Datta's observation of the gendered nature of water access in *jhuggi-jhompri* clusters (self-built, unauthorised, unrecognised settlements) and slums (Datta, 2012; Truelove, 2011). In parallel to Vicky Walters work in

Bangalore, Truelove also considers the limitations of an NGO project to improve water supply to an urban slum (Truelove, 2016). A PhD thesis by Katherine Tovey describe the phenomenon of '*gali* [lane] pipes' in slums, and the role of lower DJB officials and politicians in facilitating this (Tovey, 2002). Alankar's PhD argues decisively that inequality is a greater issue than the claim of insufficient bulk water provided by the DJB (Alankar, 2009). A paper by Alankar, and another by Marshall (by his former colleague) and Randhawa discuss the important role of place, centrality and topography for water access in Delhi (Alankar, 2013; Randhawa & Marshall, 2014). Augustin Maria raises the issue of groundwater as an unremarked supplement to formal supply (Maria, 2006, 2006, 2008). Maria's PhD also analyses opposition to water privatisation in Delhi (Maria, 2007). Suresh Rohilla's PhD and an occasional paper discuss again the role of groundwater and its disconnect from Delhi's planning apparatus, with a focus on Dwarka sub-city (Rohilla, 2006, 2012). Hosagrahar traces the historical and architectural influences on contemporary Delhi's water supply (Hosagrahar, 2011). Awadhendra Sharan, too analyses the history, with good material on colonial knowledge production for water supply improvements (Sharan, 2011, 2014). Sudipta Biswas analyses the formal system in two planned neighbourhoods and still finds significant levels of inequality which he attributes to political influence (Biswas, 2015). A paper by Woolcock and Jha discusses the role of *pradhans* in both facilitating and *obstructing* water supply to slums (Jha et al., 2007). Other papers from World Bank staff consider off-network water in Sangam Vihar (Kacker & Joshi, 2012, 2016). The Cities of Delhi project from Centre for Policy Research has produced a good discussion paper on the DJB and unauthorised colonies (Sheik & Banda, 2016; Sheik, Sharma, & Banda, 2015). Working Papers from Centre for Civil Society contain interesting empirical material on services in Sangam Vihar (Daga, 2003; Das Gupta & Puri, 2005).

Informalities in public sector water governance in urban India are the subject of only a few detailed qualitative papers, the majority on Mumbai (Cooper 2011, Anand 2011, 2012, Ranganathan 2013, 2014, Björkman 2011, 2014, forthcoming) and mentioned briefly in others (Berenschot 2010, 2011a, 2011b, Gandy 2008). A new paper from Desai and Sanghvi describes the politicised informal water supply through borewells and municipal tankers in an unauthorised colony in Ahmedabad (Desai & Sanghvi, 2017). The literature suggests that access to municipal water, particularly for lower income groups, requires a diverse array of

strategies to place pressure on municipal officials and elected representatives (Coelho 2006, Anand 2010, 2012). Informality is present politically (in tactics for influencing local officials), economically (in informal funding flows for water access), and physically (in unregistered connections, and illegal pipelines).

Coelho's (2006) work on water access in the context of management reform in Chennai's public water supplier shows the ways in which these politically negotiated exceptions can become sedimented into the fabric of the city. Temporary 'bypasses', 'workarounds' and 'fixes' in the water distribution network quickly become stabilised and accepted as part of the structure, which is in any case, of such complexity that the 'official' network may only be known in certain areas to local engineers, and in its totality, not at all. Gandy's historically situated overview of Mumbai's water stresses the need for specificity and grounded local work. Groundwater, tanker mafias and the fragmentation of urban water are all mentioned, briefly (Gandy, 2008). Gandy's impressive synthesis presents a vision of dysfunctional technocracy and elite capture in which ordinary people's agency is strikingly absent and we learn little about the daily realities of water in the city.

More fine grained studies have come from anthropologists. Also in Mumbai, Nikhil Anand brings greater focus on political discretion, material factors and knowledge in urban water supply (Anand, 2011, 2012). Building on work by Swyngedouw, Kaika, Gandy and MacFarlane, Anand moves to a more finely grained analysis of the ways in which urban water is made to flow, and the material influences on it. His intention is partly to illustrate the ways that water is constitutive of everyday city politics through introducing the agency of informal settlement dwellers, and to balance this with the material ways in which water resists attempt at control and management. At time of writing Anand's book has just been published (N. Anand, 2017). Anand traces the colonial and postcolonial impacts on water in Mumbai. Anand argues that water is not only 'figured by particular technopolitical formations' but also 'exceeds politics and destabilizes its distribution regimes' (N. Anand, 2011). Anand's research found that slum dwellers can get water connections pipes by requesting a standpipe and then connecting pipes to it at their own expense (N. Anand, 2011, p. 549). This contrasts with Delhi where there is established process for water supply

to unserved areas, but pipes and other infrastructure may be self-provided or developed through politicians' local funds.

In a similar vein, Lisa Björkman's work is also closely attentive to the material and political configurations that unstable urban water supply gives rise to (Björkman, 2014a, 2014b). Björkman explicitly links water supply issues to the innovative land-use policy (Transferable Development Rights) that Mumbai developed in order to incentivise slum redevelopment. By detaching urban density from the city masterplan, this led to 'hydraulic chaos' in which the water board had no way of providing appropriate levels of supply. Björkman (and Anand) discusses how the materialities of Mumbai's water network prevent any simple determination of its performance through social and political influence. A related theme is the situatedness and personalisation of knowledge. Björkman extends these insights to argue that rather than political power and knowledge influencing water supply, power and knowledge of water supply allows individuals to influence politics (Björkman, 2015, p. 198ff.).

Anand and Björkman urge us to move beyond simplifying binaries; for Anand connection and disconnection; Björkman the (formal) plan and (informal) 'anti-plan'. However, while all three consider informalities in water supply, non-network water is never subject to a sustained discussion. Anand mentions how the presence of a borewell in a settlement allows a different political possibilities by reducing reliance on the public network (N. Anand, 2011, p. 557). Anand observe discrimination against Muslim settlers in Mumbai, by Hindu nativist politicians (N. Anand, 2017). Björkman uses the image of tankers to illustrate Mumbai's 'fitful taps' but her work is solidly focussed on the public network and illegal connections to it (Björkman, 2015). Further discussion of informalities in urban water in India occurs across a series of individual papers.

Qudsiya Contractor, who did earlier work in the same neighbourhood as Björkman shows similar political dynamics (Contractor, 2012). In work on Mumbai and Bhubaneshwar, Cat Button and Kajri Misra both highlight the vast amount of private, individual infrastructure in middle-class areas that allows India's urban water networks function (Button, 2016; Misra, 2014). Graham, MacFarlane and Desai's paper on Mumbai's water, addresses informality

explicitly and considers the function of talk of the 'water mafia', but, again, focusses on the public network (S. Graham, Desai, & McFarlane, 2013).

In further work on Mumbai, both Contractor (2012) and Cooper (2011) suggests that the political economy or social capital elements of informal water access leads to localised natural monopolies at neighbourhood scale. Research on access to water in a low-income Muslim community in Mankhurd, east Mumbai (Contractor 2012) explicitly builds on the work of Anand, Hansen (2001) and Berenschot to show how several layers of intermediaries negotiate water access for socially and spatially peripheral areas of Mumbai. The municipality is seen by residents as indifferent towards undersupply in the area, particularly since a change of political allegiance in municipal elections. The indifference is exacerbated by the informal income opportunities for it provides for municipal workers. At the same time, the 'water brokers' or 'water mafia' organising supply in response to the shortage are used to symbolically perpetuate representations of the criminal (Muslim) poor in media and official discourse. Cooper's study in a south Mumbai *basti*[13] found that the inadequacy of municipal water service led to small-scale entrepreneurs arranging connections. This lucrative informal economy has expanded into other service areas and formed coalitions between community-based water-supply organisations, gangs able to provide security/consent, and local politicians with channels of influence into the Mumbai bureaucracy and police. When redevelopment approval was obtained for the area, plots corresponded 'unsurprisingly' to territories in the slum associated with rival networks (Cooper 2011:89). In this case, the splintering of water supply in the informal economy led to a fragmentation and appropriation of the power over, a range of other urban services, ultimately dividing land and housing redevelopment along the same lines. Power over water becomes power over land and urban development. (In my research power over land becomes power over water – see Chapter Five and Six.)

While centralised public sector water networks are used in India, they are not the main source for most people, even urban dwellers (M. Shah, 2016). Resonating with Roy's suggestion above, that the differences within and between informalities are important areas

[13] Hindi, noun. settlement, used for JJ clusters and slums

of research, Anand suggests that while scholarship has raised the embedded politics of technologies, there has been less consideration of the specific effects of particular infrastructures, or 'the manner in which the peculiar materialities of technologies matter' (N. Anand, 2017, p. 11). I extend this argument to suggest that means of water provision outside the public network, a significant source of water in Indian cities, are also worthy of attention.

Work on 'off-grid' water - tankers, wells and bottled water - is less developed than work on public sector networks. Until recently, at least, there was more work from policy-focussed organisations such as the World Bank, often in support of a policy position (e.g. Easter, Rosegrant, & Dinar, 1999). Prominent early academic research on water connecting the formal and informal is Eric Swyngedouw's study of Guayaquil, Ecuador. Swyngedouw suggests that in Guayaquil the formal water utilities concentration on the central city served to protect politically connected tanker business in peri-urban areas (Swyngedouw 2004, 2006:38). In Delhi, water tanker operators are the most visible face of the 'water mafia' and sensational media stories have often focussed on them to the exclusion of tubewells, bottled water, illegal plumbers and corruption in the DJB. For example:

> 'The water mafia created 'artificial water crisis' situation in various posh colonies the day Kejriwal announced 700 litres of free water per day to each household in the city' (S. K. Singh, 2014); 'Mrs. Kaur and her neighbours depend on private suppliers, who deliver water in truck-sized tankers […] Activists like Mr. Porwal allege that businessmen working with the ruling Congress party and the opposition Bharatiya Janata Party run the private water supply operations through tankers' (Manish, 2013)

The term 'mafia' in south Asia is used slightly loosely and does not necessarily carry the connotations of powerful crime families common in popular media or the control of an illegal market through the use of violence that a strict academic definition might give (Schneider & Schneider, 2008, p. 362). In work on Mumbai, Graham et al state that 'dominant discourses surrounding Mumbai's contemporary water crisis' 'deployed by elites and mainstream media outlets' 'tend to simplistically equate the city's poor citizens with the interests of a powerful and shadowy "water mafia"'. They suggest that water mafia talk, by 'failing to reveal how such corrupt water practices negatively affect Mumbai's poor' renders

the exploitation of residents of informal settlements 'all but invisible' (Graham et al., 2013, pp. 118–119). This is not the case in Delhi, where 'water crisis' is much more likely to be blamed on interstate allocation issues. Water mafia are a common theme, particularly in the Daily Mail, however, they are usually presented as unscrupulous entrepreneurs profiting from the distress of low-income communities, who are almost always quoted stating their unhappiness[14]. Taking news articles from the top of Google's search results for 'water mafia Mumbai', in fact a similar pattern emerges. Low income residents are described as angry and frustrated with lack of water and blame 'water mafia' for making money from their situation (Indian Express, 2016; Raina, 2016). Regardless of the accuracy of Graham et al's claim, the intuition that water problems may be blamed on low-income residents is sound. Björkman, Anand and in another context Ghertner, make this point persuasively (N. Anand, 2012; Björkman, 2014; Ghertner, 2012).

Björkman in her recent book, and elsewhere, is very sceptical of 'water mafia' talk and describes the empirically dubious but rhetorically powerful use of 'water mafia' in Mumbai (Björkman, 2015, pp. 180–189). She describes talk of corruption in tanker delivery of municipal water as symptomatic of the complex public system and widespread use of brokers and side-payments. She does quote a tanker owner who describes profits made from black market sale of municipal water but does not find evidence of any cartel. Qudisya Contractor's research in the same area of Mumbai provides an illuminating description of the criminalisation of 'water brokers' and their media portrayal as 'water mafia' (Contractor, 2012, p. 63). However, while Mumbai's water politics primarily revolves around municipal pipe supply (and resale of municipal water), in Delhi, the situation is quite different. A large factor in this is the presence of heavy groundwater use. As Mehta observes 'institutional arrangements governing natural resources management are often elite-driven, exclusive, messy and conflict-ridden' (L. Mehta, 2005, p. 25).

The connection between illegal groundwater use and water tankers is explored in Malini Ranganthans' excellent paper on the 'tanker mafia' in Bengaluru. She finds that the imagined nexus of politicians and tanker bosses is reflected in the public authority of tanker

[14] See also e.g. (Sethi, 2015; Majumder, 2015; Times of India, 2012; Munshi, 2012)

bosses which is modelled on the styles of politicians (Ranganathan, 2014a). Ranganathan also highlights the links between informal water and informal land development (Ranganathan, 2014a, p. 91). The water mafia in Bengaluru is said to have demarcated territories (Borthakur, 2015, p. 25; Rai, 2012), a finding reported in other cities also (Kjellén & McGranahan, 2006). However, it should be noted that as I also found, tanker owners and other informal water providers seem reluctant to participate in research. In Borthakur's study two tanker owners agreed, and two declined, to participate. In Joshi and Kacker's study in Sangam Vihar, eight households and four water managers participated (Kacker & Joshi, 2016, p. 257). These difficulties in access are perhaps a factor in the patchy information available. For example, several researchers state that tanker prices are fixed (Panda and Agarwala 2007, Goldar and Misra 2008, Daga 2010, Srinivasan 2010) – except in conditions of scarcity when they vary according to the client's ability to pay. Srinivasan et al discuss tanker supply in Chennai (Srinivasan et al., 2010). Greater non-monetary costs are also required for tanker or tubewell water, a burden that falls disproportionately on women (Truelove, 2011) and children (Datta, 2012, pp. 136–139).

On urban groundwater, work by Deepak Malghan and colleagues from Bengaluru (cited above), introduces concept of urban hydrology as socio-natural. Municipal tap capture by criminal groups *is* described in work on Mumbai (Bapat & Agarwal, 2003, p. 82; Weinstein, 2008, p. 26). Tap capture by local groups, along caste or communal lines, is also described in Patna (Rodgers & Satija, 2012, p. 4). A connection between water tankers and tubewells is also, cursorily mentioned by Graham et al in work on Mumbai: 'private water tankers also obtained water from bore wells, pointing to profits being made through excessive and often unregulated groundwater extraction' (Graham et al., 2013, p. 135). There is also a 2016 Joshi paper on Delhi tubewell networks, the data is ten years old but similar to my findings on tubewells in Sangam Vihar. There is just one page on borewells in Anand:

> 'With their own patrons, bore wells have their own management regimes, and produce their own political and social networks that run through and parallel to municipal systems of legitimation and patronage. Wells therefore produce different forms of political authority and regimes of belonging in the city' (N. Anand, 2017, pp. 212–213).

CONCLUSIONS

This project was motivated by an attempt to understand the relationships between reforms and informality in urban infrastructures and governance. My interest here is in the effects of reform programmes like new public management in urban governance or the commercialisation of urban services. Ideas about the state and politics in India from the literature discussed above are an explanatory theme that runs underneath discussions of informality, water and reform throughout the thesis. I am broadly sympathetic to work on neoliberalisation without wanting to sacrifice empirical accuracy for theoretical coherence or ideological purity. At the same time, while there has been extensive work on neoliberalism and water privatisation (e.g. V. Asthana, 2009; Gopakumar, 2011; Walters, 2013), 'actually existing' water arrangements in Indian cities are not heavily discussed. An initial research question for this project was 'how *do* people access water in Delhi?' Despite fairly wide reading of the literature, the answer was not obvious. The coexistence in Delhi of commercially-led water governance reforms and progressive government-led reforms provided a compelling site for comparative research.

I suggest that infrastructure studies can contribute to debates on informal urbanism by providing contrasting and sector-specific dynamics to the predominant focus on informal land-use and enterprise. Additionally, infrastructure leads us to think about the material and technical processes that may be overlooked in studies of informal land use or labour. Conversely, attention to informality contributes to infrastructure studies by forcing us to attend to the interface of technical and regulatory aspects with social and interpersonal dynamics, and the impacts on the lived experience of users. Informality forces us to question the apparent boundaries of systems (technological, natural, political, etc) and the enactment of apparently neutral categories and actors (technical systems, state agencies, political processes) (Latour, 2005, p. 37; Mol, 2002, p. 32). I suggest that research on informal infrastructures and their 'small technologies' (K. Furlong, 2011), like water tankers and tubewells, might speak usefully to theorisations of both informality and infrastructure. Work from the global south might also provide a fresh approach to a subject that has been northern dominated. De Laet and Mol's work on water pumps in Zimbabwe is a good example (de Laet & Mol, 2000). The empirical material in this thesis will attempt to show

the importance of further refining work on informal infrastructures to account for: local dynamics and their historical trajectories; sector and supply mode specificity and the relationships between them; the underestimated extent of these socially embedded modifications and the obstacles that they can pose to reform initiatives. For example, water has specific material characteristics unlike other infrastructure systems and must be understood in relation to wider ecology. Hydrology, particularly in urban settings, is a combination of social, cultural and political as much as material, natural and ecological processes. Access to water is structured by gender, class, caste and religion, as well as material factors such as slope, distance, geology.

The literature above indicates that informality is multi-dimensional: the rule in relation to which something is considered informal must be specified. General theories of urban informality will become problematic when applied in other settings. Infrastructures informality and state are performative – they exist through action. The greater the level of informality the greater the degree of performativity. Infrastructures, like informality and the state, are relational; the extent of the system and its edges are a function of the scale that is being studied. For example, mediators and brokers are essential elements of the Indian state's blurred edges. Indeed, concepts and systems like 'state', 'civil society', 'democracy', 'public-private partnerships' may change as they are transported and implemented across sites. Reforms aim to rationalise urban governance and services appear to be in tension with pre-existing practices which may follow other (more or less benevolent and exploitative) logics of profit and politics. However there has been limited research on the relationship between urban reforms and informality, particularly in relation to water.

Using the conjunction of water reforms and informality as an angle for research into the governance and politics of water directs the research methods and choice of site. The overlap between informal water and groundwater use in much of India is evident in Delhi, which is also the site of reforms under a number of pilot projects for commercial management of water as well as changes brought in by a new government in the city. Later in the thesis I discuss state piped water supply (*Chapter Four*), non-piped and informal 'off grid' water (*Chapter Five*), and a public-private partnership in the city (*Chapter Six*). The

research discussed in this chapter was used to frame the methodological considerations and choices that I made in designing and executing my own project, which are the subject of the following chapter.

CHAPTER 3. METHODS

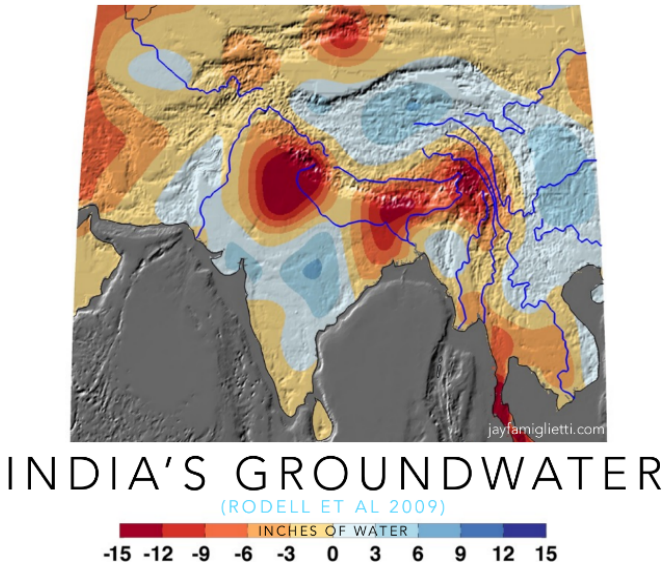
In this chapter I discuss the study design and methods chosen for this research. I open the chapter with a discussion of Delhi as a site before moving on to describe my specific research focus areas of Sangam Vihar-Deoli and the Malviya Nagar Public-Private Partnership (PPP) zone. I then describe the process of data collection, theoretically and practically. In closing, I consider research ethics and positionality, and limitations of the proposed research.

The initial broad research question I ask is: '*How is water governed in Delhi?*' More specifically, *'How and why does water affect politics and politics affect water in Delhi?'*, or again *'What are the politics of Delhi's water, and the hydraulics of Delhi politics?'* Gaps in the academic literature led to three main sub-questions:

1. *How is public supply governed, and what are the roles of politics, planning and informality in public water supply?*
2. *What role does groundwater play, what are the roles of politics, planning and informality in ground water use, and why?*
3. *What relationships do unreliable, unequal public supply, groundwater, politics, planning and informality have with water reform initiatives?*

I used two interventions – one from government, one from the private sector – as windows onto water governance in Delhi. The first was attempts to regulate the 'water mafia' in Sangam Vihar, a large cluster of unauthorised colonies. The second an attempt to transfer the public network to private management in a zone of mixed tenure types and incomes around Malviya Nagar. In addition to these two primary focusses, and specific neighbourhoods within then, I also conducted research in other similar South Delhi neighbourhoods for comparison.

Despite being India's capital, Delhi's water supply is below average and near the bottom end of India's major cities (Shaban & Sharma, 2007). Estimates place the proportion of population relying on piped supply from the Delhi government at around 50% (Jain, 2012; Maria, 2008; Narain, 2011). The unreliability of official water supply timings and quality leads to a common use of alternative access modes, which complicates any simple model of supply dynamics. One common solution is the use of groundwater on which Delhi is considerably dependent to supplement its water supply, both through the Delhi Jal Board (DJB) and alternative suppliers. In south Delhi, like many of India's fastest growing cities, groundwater use is pronounced and the water table is declining rapidly – see Figure 3 (Rodell et al., 2009).



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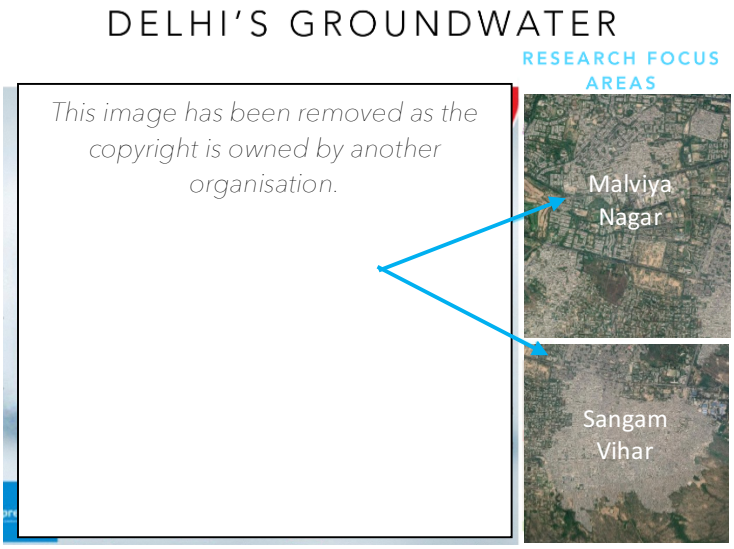


Delhi's groundwater and project research sites
(map data Google 2018, image data Digital Globe 2018)

Groundwater in the south of the city has been falling at 10-15ft per year leading to wells up to 650ft deep. At around this level groundwater usually reaches the end of viable use – becoming increasingly *khada* (hard / salty) and non-potable as well as damaging the submersible pumps used to extract it. Data from the Delhi Development Report (from Institute of Human Development) shows South Delhi as having a higher proportion of residents living in slums than other areas of the city, and these residents as using a far greater variety of water supply modes than elsewhere (Marie-Hélène Zérah, 2000b, p. 297, mentioned earlier at page 58 above). One reason for this is that Delhi's bulk water

infrastructure is concentrated in the north of the city. Given the high levels of inequality, neighbourhoods in south Delhi receive both very high, and very low amounts of water. The Mehrauli zone, in the far south is, according to the available data, the zone receiving the lowest amount from the public network. In this, south Delhi is similar to India as a whole, where, while centralised public sector water networks are used, they are not the main source for most people, even urban dwellers (Burt & Ray, 2014; M. Shah, 2016). The parts of Delhi most resembling the 'ordinary cities' of North India are those across the state boundary (Ghaziabad, Faridabad, Gurgaon). To avoid the additional complexities of research in a site under a different state government, I selected research sites in South Delhi. These are described in more detail below.

Even within Delhi, the water supply is highly spatially differentiated, as Zérah's clustered survey of Delhi neighbourhoods illustrates (Marie-Hélène Zérah, 2000b). More recently Biswas has demonstrated the variations within formal areas of the same part of the city (Biswas, 2015). Water access can be sub-divided into official formal supply and alternative methods of water access. The predominant household [or neighbourhood] access mode is likely to be a function of a range of factors including planning status, physical geography (topography and geology) and social indicators such as income group, religion and political alignments, etc. Determinants of water supply within this area of south Delhi may be of an intricacy that the division between 'public' and 'private' management begins to seem rather crude and arbitrary.

Part of the reason for the high level of variation in water supply is that Delhi's built fabric is very mixed in terms of density, age, construction quality, and land-use (Dupont, 2004). Inequality has been hardwired into Delhi's urban planning, first by the British with Civil Lines and Lutyens' New Delhi, then post-independence, through the Ford Foundation Masterplan and the demolitions of the Emergency. The historical development of the city has led to unequal water supply. Both Mughal and British rule entrenched a pattern of focus on bulk supply directed towards ruling classes and a neglect of intra-city inequality. With the new developments of Shahjahanabad and Civil Lines in the north of the city and then Lutyens' New Delhi further south, bulk water infrastructure was concentrated in the north. Public supply was stretched by the fast growth of the city in the wake of partition, particularly in

the south and west, while the high-modernist master plan adopted in the 1960s further formalised spatial divisions. The growth of these new areas at a distance from the centre raised costs of provision, particularly in the south of the city which was far from the water inputs and treatment plants, and 'behind' the heavy bulk consuming areas of New Delhi and Cantonment. A further layer of complexity is given by the inadequate supply of low-income housing which has led to a majority of the city population living outside the planned city, and consequently facing restrictions on public services.

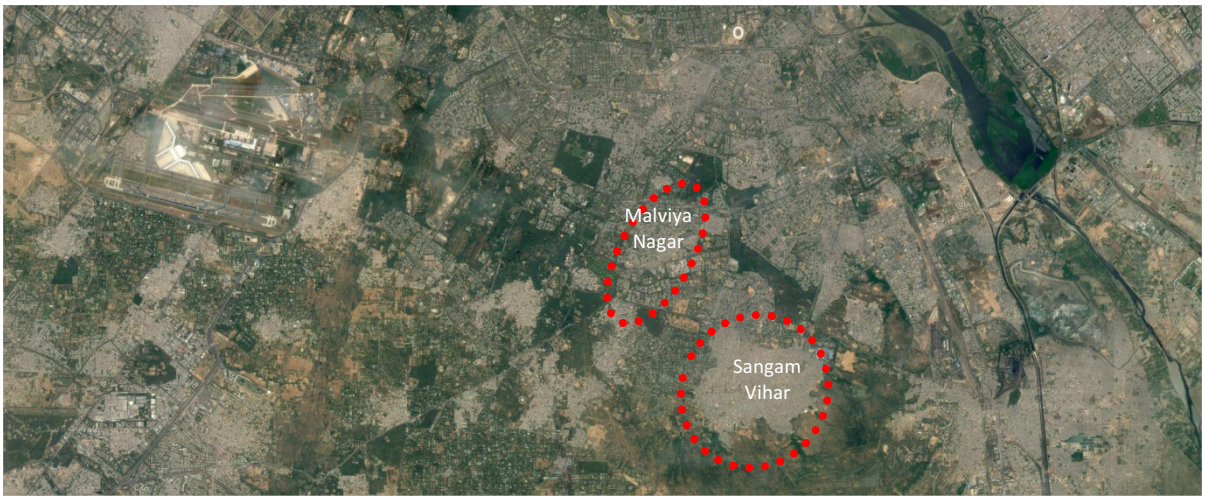
The DJB typology of informal urban areas itemises *jhuggi jhompri*[15] (JJ) clusters, recognised slums,[16] resettlement areas,[17] urban villages, rural villages, unauthorised colonies and regularised unauthorised colonies[18] (Bhan, 2013; Ghertner, 2010). In brief, JJ clusters, slums and unauthorised colonies are areas urbanised without planning permission; recognised slums and regularised unauthorised colonies have been granted some official recognition; resettlement areas rehouse evictees from other, more central, informal areas; and urban and rural villages were deemed to require lower standards of urban planning than the surrounding city.

Within these categories, a salient feature of Delhi's urbanisation and politics is the presence of 'urban villages' and 'unauthorised colonies'. I chose to focus on unauthorised colonies and urban villages in South Delhi as 'ordinary' areas with irregular water provision beyond the 'slum-elite' binary (Chakravarty & Negi, 2016; Lemanski & Tawa Lama-Rewal, 2013; Robinson, 2005). While the city has been built on village land, urban villages have not disappeared and are a distinctive feature of Delhi's landscape (Chakravarty, 2016; S. Kumar, 2010; Sengupta, 2007, pp. 132–154). A number of villages were incorporated into the city and declared 'urban villages' by the 1962 Masterplan (Sengupta, 2007). Delhi's urban growth since 1931 has overtaken surrounding 132 villages (Mehra, 2005, p. 284) and there were 135 declared urban villages in 2007 (Chakravarty, 2016, p. 117). The term

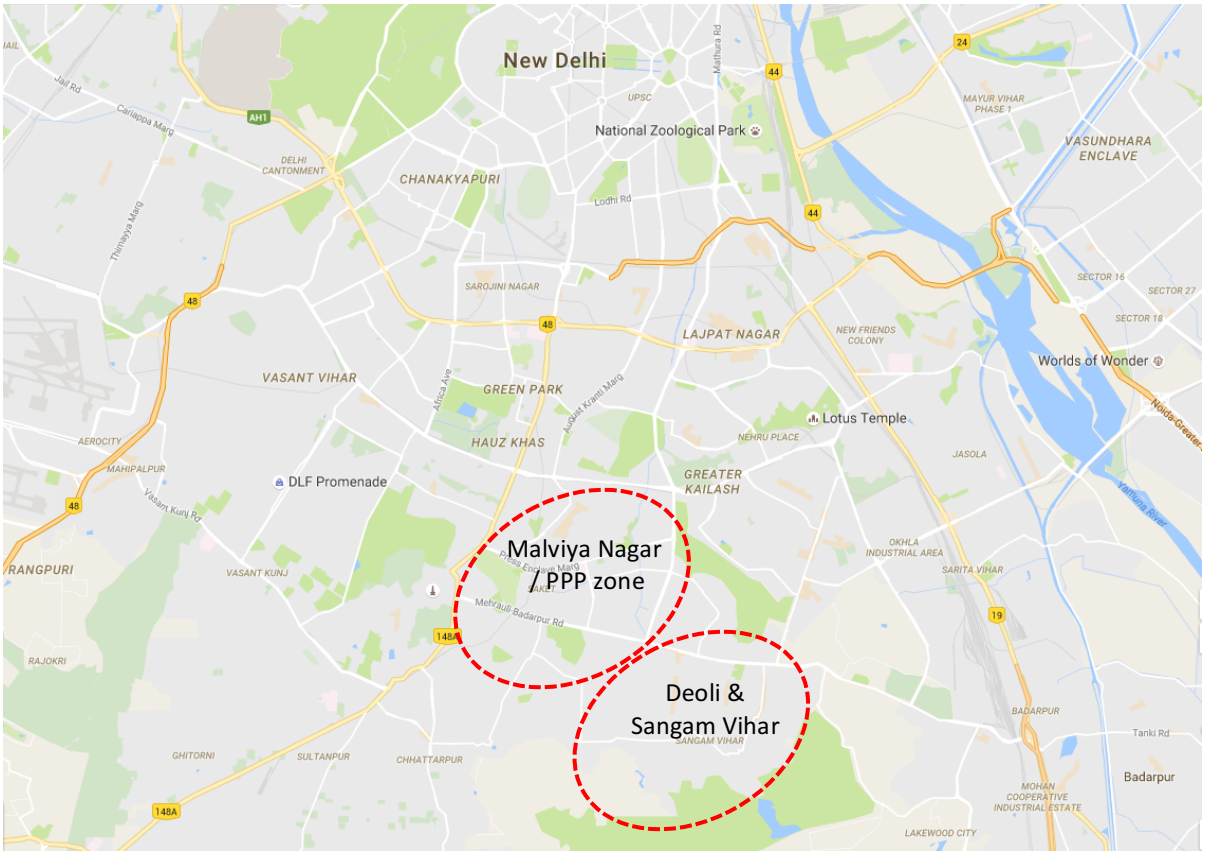
[15] *jhuggee jhompdree*- Hindi n. 'hutments' (literal tr. / Indian English) / huts, shacks. *Jhompdree* hut, hovel, cottage, also cell as in insect colonies, derived from *jhomp* Hindi n. sleep.
http://www.oxforddictionaries.com/definition/english/jhuggi
Hindi dictionary Pustak.org defines jhuggi as 1. a fakir, sadhu etc's hut 2. any very small house
[16] JJ clusters acknowledged by government, which may be provided minimal services
[17] (Bhan & Menon Sen, 2008; Srivastava, 2015)
[18] for which see *inter alia* (Sheik, Banda, Jha, & Mandelkern, 2015)

'unauthorised colony', is connected to 'urban villages'. It refers to urbanised areas on agricultural land which had not been rezoned for the new use at time of sale.

While there has been much work on India's slums and 'slumification' over past decades, the unauthorised colony is an almost neglected typology outside of India, generating one publication with the term in the title in international journals (Lemanski & Tawa Lama-Rewal, 2013). Urban villages, on the other hand, although less studied in India, have been discussed extensively in China (Wang, Wang, & Wu, 2009; F. Wu, Zhang, & Webster, 2013; Yan Song, Zenou, & Chengri Ding, 2008). Nevertheless, both unauthorised colonies and (to a lesser extent) urban villages, are central to Delhi's political and social equations (India TV News, 2012). For unauthorised colonies, known in Bangalore as 'revenue layouts' (Sundaresan, 2013, p. 25) see (Dupont, 2005; Lemanski & Tawa Lama-Rewal, 2013; Ranganathan, 2014b; Sheik & Banda, 2014, 2016; Zimmer, 2012); for urban villages - (Baviskar, 2003, p. 90; Chakravarty, 2016; S. Kumar, 2010; Mehra, 2005; Sengupta, 2007). As areas constructed outside of planning oversight but not as marginalised and insecure as *bastis* or slums more similar to the mundane and unplanned urbanisation in India's 'ordinary cities' where the majority live.



South Delhi, primary research sites. Urban density, a reasonable proxy for class, is clearly visible (imagery: Digital Globe 2018; map data Google 2018)



South Delhi (map data: Google 2018)

Research Focus Site A) Sangam Vihar, Deoli and surrounds

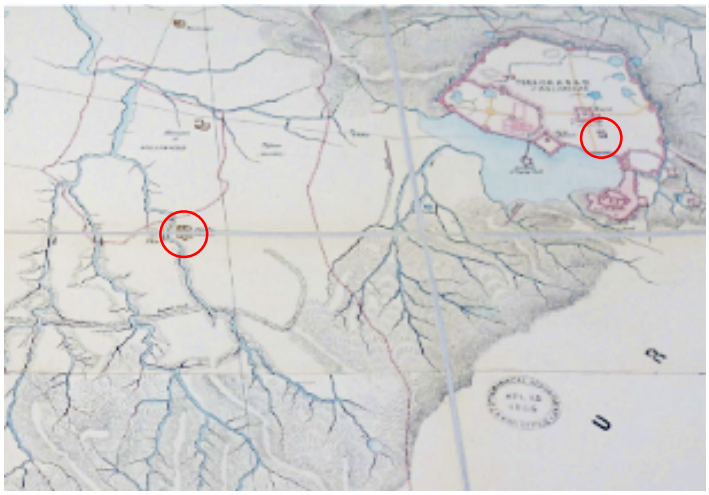
My first set of research sites are neighbourhoods within the Sangam Vihar and Deoli constituencies of Delhi Assembly. Sangam Vihar is a large low-income area by the Delhi state border which was urbanised without planning permission and now houses around a million people. The area had no government piped water supply at all until 2015 when the AAP government began introducing it. Because of this lack of piped water, I approach Sangam Vihar as a 'limit case', or extreme example, to better examine water supply outside of the piped network, and in particular the role of informal groundwater use. Sangam Vihar as a site helps to address my overall research question ('How is water governed in Delhi?') through the sub-question 'How do people access water outside the piped network? / What role does groundwater play, and why?' This then feeds into the analysis, in later chapters, of network reform projects – where informalities and groundwater use are also present, although less starkly.

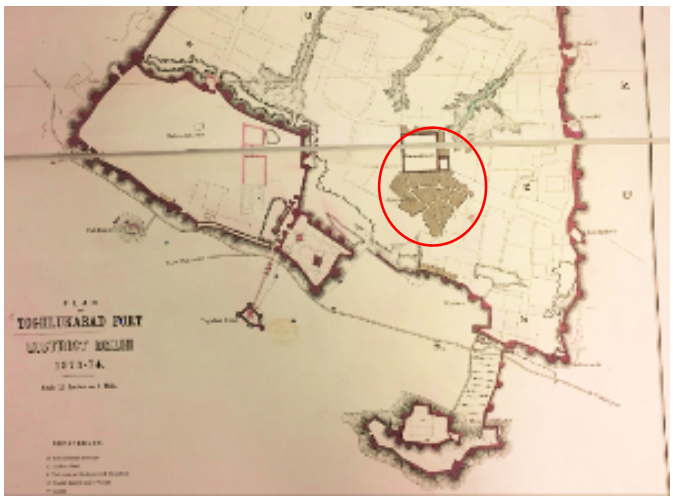
Sangam Vihar displays a densely built-up urban environment of regular plot sizes
(magery: Digital Globe 2018; map data Google 2018)

Although, Sangam Vihar is a distinct spatial formation (as can be seen from the aerial photographs above), it is composed of thirty eight unauthorised colonies and divided into two legislative assembly areas. As a location of unauthorised urban development at the south-eastern periphery of Delhi's state boundary, rental prices are low. The majority of residents earn low incomes and very many families are from outside Delhi (Sheik, Banda, Jha, & Mandelkern, 2015). The name reflects these varied origins – '*sangam'* means confluence of people or rivers – and is said to have been given because of the mix of different people living there. Sangam Vihar is bordered to the south by the Asola Wildlife Sanctuary, created in 1986[19]. To the west is Sainik Farms, clearly visible from the air and on the google maps image by the change in density, a very high-income unauthorised colony fairly densely packed with around 5,000 multi-story luxury villas with gardens on individual plots (Sengupta, 2007, p. 173). While not of the opulence and spaciousness of the villas in the Chhattarpur-Mehrauli-Fatehpur Beri strip[20] (home to Delhi's wealthiest Members of the Legislative Assembly and his collection of luxury cars, p.57), Sainik Farms is very well known as a home for "Delhi's 0.1%"[21]. The size of houses constructed on land zoned as agricultural were restricted in the 1961 masterplan, but by 1982 the size limits had increased 1,000 percent (Sengupta, 2007, p. 174). To the north west is the village of Deoli and the unauthorised colonies, resettlement areas and villages of Khanpur and Tigri. Further east,

[19] Thomas Crowley, researcher, Akademie Schloss Solitude, Stuttgart, personal communication, 9 November 2016
[20] See (Soni, 2000)
[21] Personal communication, journalist, *The Caravan*, South Delhi, February 2014, fn46; Personal communication, Alankar, Centre for Study of Developing Societies, Delhi, 24/09/2014, fn32.

Sangam Vihar's northern side is bounded by the Mehrauli-Badarpur Road and the Hamdard Institutional Area, including Indo-Tibetan Border Force and Indian Airforce bases. To the east, is more army land, Delhi shooting range, Asola Sanctuary, and beyond these, the industrial areas of Okhla, Badarpur, and, across the state border, Faridabad and NOIDA. The village of Deoli can be seen centre left on the 1866 map below, as well as the Gujjar village inside Tughlakabad fort, shown in more detail in the 1873 map on the right. These maps also indicate the areas hilly topography and the reason for the extensive flooding. The area that is now Sangam Vihar is lower than surrounding areas and the eastern side was at one time a lake.





(left) 1850 map of Sangam Vihar area shows villages of Deoli (left) and Tughlakabad (right) circled in red
(Burgess, 1866, © British Library Board, Maps I.S.79)
(right) Plan of Toghlukabad Fort 1873-74, 'Goojargaon', considerably larger than the 1850 map, is circled in red
(Captain W. H. Wilkins, Offiz Depy. Supt & Assistants, 1876, © British Library Board, Maps I.S.152)

As with much of Delhi's southern fringes, the region was previously farmland, orchards, grazing land, forests, scrub and rocky outcrops occupied by villages settled within and around the older cities of Delhi (Qila Lalkot, Mehrauli, Siri, Jahanpanah, Tughlakabad). South Delhi's villages were primarily dominated by Jaat (c.30%), Gujjar (c.20%) and Yadav (c.12%) communities, with an inner ring of Jaat and Yadav villages on areas better suited for farmland, with Gujjar villages on the more rocky and outer-lying areas[22]. The adoption of land less suited for agriculture is likely to be because Gujjar people have traditionally been

[22] On spatial distribution of castes personal communication with researchers working on caste and land use in Delhi - Tom Cowan, Swastee Ranjan, Tarini Manchanda.

pastoralists. In common with other nomadic communities, they were classified as 'criminal tribes' under the Criminal Tribes Act of 1871. A reputation for 'toughness' and criminality persists to date ('Ethnic groups in Delhi', 2016). The land on which Sangam Vihar is built previously belonged to Gujjar landlords from village of Tughlakabad and Jaat villagers from Deoli[23]. The village inside Tughlakabad fort is marked 'Gujjargaon' [Gujjar Village] on the map overleaf. The local MP (Member of Parliament) is also a Gujjar from Tughlakabad as are other political players and real estate dealers[24].

Despite its large size, the urbanisation of Sangam Vihar has similarities to Delhi's other peripheral unplanned neighbourhoods. The area is a vibrant, lively locality with many small businesses, proliferating range of housing types, often clean and nicely painted, and a feeling that rules are relaxed, as well as a certain reputation for crime. Sangam Vihar is associated with 'gangwar' and violent crime in popular media[25] (Indian Express, 2013, 2015c, Manral, 2015a, 2015b; News 24, 2015; Times of India, 2016b). To get to Sangam Vihar's western side today, travellers must take shared auto rickshaws that run through Sainik Farms. I was shocked on an early journey when as the rickshaw pausing at a junction the young driver was hauled out bodily by two burly men, cursing him in Hindi. Another young man jumped behind the wheel and sped off. We were not being hijacked, but the driver was in trouble for not having paid his daily rent. Many people in Sangam Vihar have obvious scars, particularly those involved in politics, and the area has a 'street' feel to it.

Sangam Vihar street scenes

ihar, 18/05/15, fn83; Personal communication, water supplier and real estate dealers, Sangam Vihar, 19/08/2015, fn133; Personal communication, real estate dealers, Sangam Vihar, 06/02/15, fn17.

[24] As on Delhi's south western border Yadav's are also a presence in real estate circles. Personal communication Tom Cowan, PhD researcher, Kings University London

[25] https://www.youtube.com/results?search_query=sangam+vihar

Research Focus Site B) Malviya Nagar PPP area and surrounds

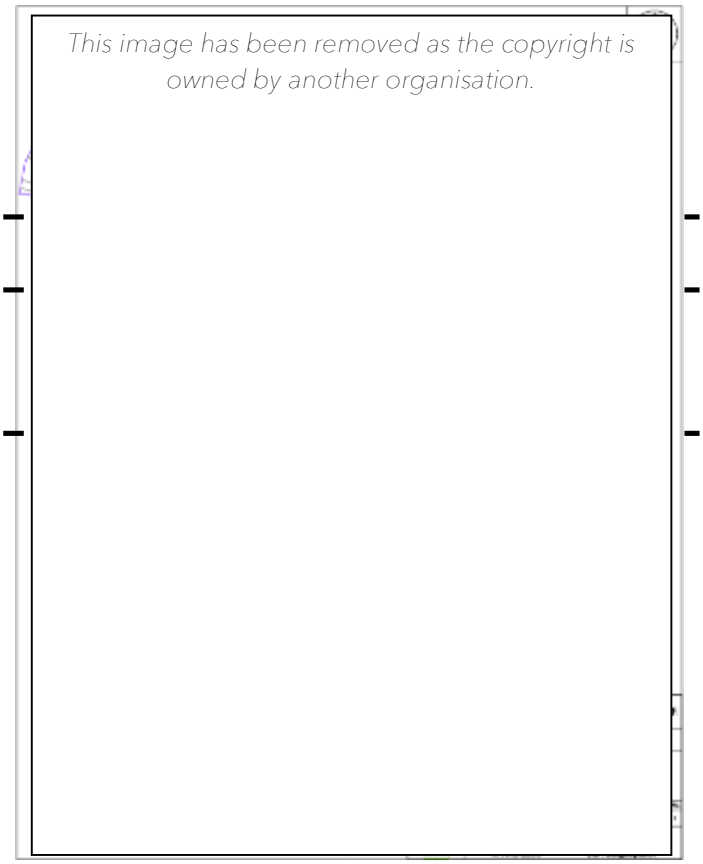
My second set of research sites, within the Malviya Nagar Delhi Assembly area, are more central and higher income, although still varied. This transfer water network management to a private operator under the PPP contract provides a unique event through which to investigate the social and political dynamics around water supply and access arrangements in South Delhi. Private sector involvement is heavily promoted by Central Government, multilateral and bilateral agencies as a means to leverage finance, expertise and technology for urban infrastructure and services in Indian cities. However, studies of this form of urban water governance in India are relatively rare (Asian Development Bank, 2011; Asian Development Bank & Lee Kuan Yew School of Public Policy, 2010; Burt & Ray, 2014; Dwivedi, 2010; Dwivedi & Rehmat, 2011; Ercumen et al., 2015; Kumpel & Nelson, 2013; Sampat & Koonan, 2012; Sangameswaran et al., 2008; World Bank, 2012). This discussion of a project in a complex and dynamic area of Delhi, 'the most favoured city' (Sivaramakrishnan, 2011), provides a second limit case of what *should be* highly favourable conditions for private sector involvement.

In 1947, the Malviya Nagar area was largely village farmland on the edges of urbanised Delhi. In 1948, land for refugee colonies in the south, at first Malviya Nagar and neighbouring Kalkaji, was selected. The agricultural land, growing 'rows and rows of vegetables', was purchased for a 'pittance' from the farmers by the district board as well as private developers (Sengupta, 2007, p. 80). Many other South Delhi neighbourhoods also came into existence as refugee colonies. Today, Malviya Nagar is well-placed in South Delhi. Despite its associations as a fairly wealthy (certainly solidly middle class) area of Delhi, the PPP zone is substantially larger than simply Malviya Nagar colony and covers a diverse range of settlement types with a population of around 400,000 (Delhi Jal Board, 2017). This includes very affluent areas (including Geetanjali Enclave, Shivalik, Panchsheel Park). There are also less ostentatious but still comfortable Delhi Development Authority (DDA) areas (Malviya Nagar, Sheik Sarai, Saket). DDA housing is public housing, but was largely constructed for middle income groups, as the low income housing was never built (Bhan, 2013). Layout and construction quality mean that these DDA complexes are now sought after neighbourhoods. At the south east corner of the zone, is a very large area of

government housing (Pushp Vihar - which has its own arrangements with the DJB as well as extensive tubewell supply). a very large area of government housing (which has its own arrangements with the DJB as well as extensive tubewell supply). To the north of the main arterial road, are a large cluster of unauthorised colonies (including Khirki Extension, Hauz Rani Extension, Panchsheel Vihar, Savitri Nagar Extension), and urban villages sometimes over a thousand years old (including Hauz Rani, Khirki, Begumpur, Lado Sarai). The zone also includes a small number of recognised slums (Jagdamba Camp, Indira Camp, Lal Gumbad Camp) and a few *jhuggi jhompri* clusters or unrecognised slums (Khumba/Gurudwara Camp, Satpula Camp…). There are also significant commercial sites including run-down public hospitals (Mohan Madan) and luxurious private hospitals (Max Saket, Saket City, south side of the arterial road), five star hotels (Hilton, Sheraton, Carlton), and high-end shopping malls (Select City Walk, PVR).

Malviya Nagar urban forms (imagery: Digital Globe 2018; map data Google 2018)

In comparison with Sangam Vihar, the Malviya Nagar area displays much greater variety of urban form. In the top row of aerial photographs below, urban villages and unauthorised colonies are visible as high density areas. In the second row the more spacious and regular plotted development of high-income planned areas can be seen. The middle photograph shows a dense linear slum in the top half of the photo and large planned households in the lower half. The third row shows dense unauthorised colony development in the first photograph, an urban village surrounded by large high-income planned properties in the central picture and institutional complexes in the photograph at right. In the fourth row we can again see chaotic unauthorised colony development, spacious planned layouts and a historical monument, surrounded by an urban village, a fairly common feature.



Map showing PPP project area (Detailed Project Report, Appendices and DMA Report, 2011, P272)

Unauthorised colonies in the Project zone

The PPP project zone, which is T-shaped can be divided into four bands, north to south (see map above). The top 15% of the zone is richer and planned, the next 10% composed more of DDA flats and unauthorised colonies, the next 15% is mainly malls and hospitals and government housing, the last 65% is peri-urban and unauthorised colonies (e.g. Dakshin

Vihar) and 'farmhouse' villas (e.g. around Neb Sarai). This mix of land-use provides a varied and challenging environment for the PPP project operator.

Delhi's 'dusty south' is not all marbled mansions, luxury villas and fancy malls. There are many low-income areas between the high-end colonies. Spending most of my time in these areas, towards the end of field work I had almost convinced myself that I looked natural while hanging out the front-driver's side of a speeding auto-rickshaw bouncing over unpaved roads with ten people on board. (The legal limit is three passengers, but with merely seven people crushed in, the 15 year-old drivers seemed to feel under-capacity and their friends would jump in for the ride.) Sure, I was hanging on, rather than sitting, Punjabi hip-hop was damaging my ears, weed smoke blowing in my face and honking 4x4s were hurtling towards us – but I was cool with this. I'd 'gone native'…

DATA COLLECTION

Informal water access is highly varied, modes may be household specific and information socially, politically and legally sensitive. Trust of research participants is vital. For example, in Davis's work in Bangalore not one respondent in 1400 interviews reported an unauthorised water connection (Davis, 2004). Some studies of water reform in India have concentrated on discourse (V. Asthana, 2009, 2011, Sangameswaran, 2006, 2009), and household surveys have occasionally been used to good effect (Davis, 2004; Marie-Hélène Zérah, 2000b). Zérah's study give an indication of the scale of alternative uses and suggest that they are a response to inadequate supply quality (especially in terms of reliability, timings, pressure and quality) (Marie-Hélène Zérah, 2000b). However, informal access is not an explicit concern and consequently she does not give information on how alternative access is arranged, how these arrangements differ across areas, or how they relate to reforms in formal supply. In-depth research on urban water access in India needs to use on-the-ground qualitative methods, particularly for understanding the politics of water access (e.g. N. Anand, 2017; Björkman, 2015). As an area of potential sensitivity, informal practices are unlikely to be written down, statistics may be unreliable, and one-off interviews may replay the official narrative. Further, as a mundane part of daily life things too obvious to mention, or best left unsaid, may only be noticed by the researcher present over a longer

period. Fine-grained understandings of informal water access and the response of water networks to changing environments requires a more qualitative approach because of the dependence on trust and understandings of complex, intimate and changing processes.

I did field research for this thesis over 18 months between 2013 and 2015, the majority between June 2014 and September 2015. As informal water supply is a phenomenon with a high degree of seasonal variation, a full annual cycle is likely to give a more accurate reflection. A longer period of fieldwork also supports the development of language skills, research networks and participant trust. My research approach was 'ethnographically informed', in that I spent extensive time with participants in their workplaces and everyday surroundings, and met with interviewees on multiple occasions as far as was possible. I lived in my research sites for a majority of the time, 12 months in an urban village and nine months in an unauthorised colony, both areas with limited and unreliable connection to the official network. The first apartment had a private, non-potable, groundwater supply available as long as the landlord had filled the tank. Disliking the 'milky' taste of the water from the taps, which I was told I would not be able to drink, I arranged for drinking water to be delivered as is common in the area. My water supplier here was a friendly acquaintance I would often see around the neighbourhood, I found out from him by chance that his water factory was located in a street that I later stayed in. This second apartment had an erratic municipal connection that I needed to turn the motor on for at 6am. Again we had drinking water delivered. The motor at a third house I stayed in had to be turned on at 4am each day or there would be no water to wash, drink, wash-up and flush toilets.

For accessing participant individuals and organisations, I used a purposive (or snowball) sampling technique, with multiple different points of entry. Connections from academia, research institutions and civil society organisations as well as cold contacts from press and municipal offices, allowed a range of initial meetings. I aimed to minimise association with any particular viewpoint, and facilitate faster access through parallel processes. Topic guides were constructed for broad categories of participant (water traders, residents, officials, civil society, academic) and modified as work progressed. A number of different methods were used to gather data. In addition to longer semi-structured interviews, informal conversations, and focus groups with local residents, some participants were more

comfortable with 'survey' style questions[26] and 'transect walks' proved useful for getting a sense of localities.

Overall, information on Delhi's water supply varies, and its accuracy is difficult to ascertain. The difficulties in doing water and energy audits in other Indian cities point to this issue (N. Anand, 2015; Birkinshaw, 2016; Björkman, 2011). The relatively limited availability of empirical data on my research topic and changing contemporary situation suggested a case study approach (Yin, 2009). A case study approach gives access to live informants, as opposed to a study of policy discourse. While surveys imposing preformed categories to give wide but shallow information, case study work allows for in-depth probing of understandings and practices that may not be intuitive to the researcher. This is useful where work is at an early stage and seeks to build initial understandings of 'how' and ''why' phenomena happen. Case study data may, however, be quite narrow, and consequently multiple units of analysis reduce a certain inevitable amount of sampling bias. Despite my enthusiasm for comparative work across sites (cities, suburbs, north/south etc) and infrastructures (e.g. water, electricity, roads, Wi-Fi), in the interests of manageability one site (Delhi) and one sector (water) was selected. Research on the implementation of water sector reform projects allowed me to retain some of my previous areas of interest in governance changes and the movement and implementation of ideas and policies. Luckily for me, Delhi contained multiple water reform initiatives.

During initial months of fieldwork, I spent time familiarising myself with the local research landscape and anyone who might be able to provide information to enable me to better focus my research project. I was hoping to conduct an ethnography of the local state's role in water provision, however as the months passed while the Delhi Jal Board stalled, postponed and transferred my request for interviews and research access, I began to develop other areas of research. I read recent PhD theses available at Jawaharlal Nehru University and the Centre des Science Humaines. I was familiar with Sangam Vihar from the

[26] Not surprisingly, people wanted to fit us into the existing categories familiar to them. If I was not a tourist, then who was I? The fact that we were asking questions and writing things down inevitably associated us with government officials in people's minds. This often led to one of two interpretations: either we were sent from some official body like the DDA to check up on housing irregularities, or else we were doing a 'survey' in which case we were expected to pose set questions with one word answers' (Tarlo, 2003, pp. 125–126).

media coverage and conversations with other academics who had worked on water in Delhi. Following a discussion with a recent PhD graduate, I decided to pay a visit to learn more about water access in an area without piped supply. Earlier research experience had proved very fruitful with the support of campaigning organisations, a model I was planning to follow by situating my research in Mumbai. While I had no contacts in Delhi to draw on I continued to look for supportive organisations to work with. I spent several months volunteering with a local NGO in Khirki, and at the offices of a research organisation in New Delhi, and met with a fairly large number of relevant organisations. However, most NGOs and campaigners were unable or uninterested in working collaboratively on water. However, I made contact with an NGO in Sangam Vihar where the manager was very friendly and interested in my project. In Khirki, where I lived (for twelve months in the village, and nine months in the unauthorised colony / extension), I made friends with a young Aam Aadmi Party activist living locally who was also interested in understanding more about water in Delhi. In Hauz Rani local politicians and RWA members were friendly and supportive. Over time I also became friendly with AAP workers in Sangam Vihar and Deoli, where the offices of the local MLAs provided a sympathetic base for research. Of the three PPP projects in Delhi, the staff at the PPP project by Suez in Malviya Nagar were very friendly and accommodating of my research interest. Staff at the PPP projects under Veolia and SPML would not meet or talk to me beyond polite introductions. I would locate contact information for various groups I was keen to talk to (politicians, NGOs, resident's associations, water suppliers and other associated workers, real estate dealers) from available sources online, on the street or in local papers, or through other contacts and then attempt to arrange an initial meeting and introductory conversation. Many of the people I contacted this way were unwilling to meet. Some would meet me and talk a little. Some would be friendly and open and I would stay in touch with them as our schedules allowed. As the time I had spent in the city increased, my Hindi improved, and I became adjusted to the processes involved, I was able to present myself as a more credible researcher and my 'success rate' at opening conversations with potential research participants increased. This was offset by the increasing number of research leads which became hard to manage and keep up with meaning that some inevitably got dropped to focus on those that were continuing to provide high quality information. As phone calls and emails to arrange meetings were typically unsuccessful on occasion I would set off to an area to interview a specific type of participant (e.g. tanker

owners in Chhattarpur, bottled water suppliers in Shahpur Jat, real estate dealers on Ratiya Marg, RWA members in Khanpur). As my Hindi and level of familiarity with my research area improved I also began to spend considerable time in those I was not already living in, in advance of and subsequent to scheduled meetings. I used this time to roam and observe the areas in the spare time that I had and engage potential participants in conversation – if they were willing after I had explained that I was a researcher. Certain groups, notably tanker owners, were very unwilling to talk once I disclosed that I was doing research. Other, such as local politicians were evasive, without actually wanting to explicitly refuse. The DJB also falls into this category, and both local staff and head office workers had been explicitly briefed not to talk to anyone without a letter of authorisation from the Public Relations Head Ms Sanjam Cheema. Ms Cheema seems to enjoy a frosty relationship with the researchers and campaigners and provided very adept at avoiding my requests to meet or obtain access. This rather improvised style of qualitative research allowed me to cover a fairly large area in some depth, and was particularly useful in allowing me to talk with diverse groups of people who often had different, and opposing, stories to tell.

In Sangam Vihar I have spoken to over a hundred residents across eight blocks, six municipal wards and both legislative assembly areas, mostly in unauthorised colonies but also in urban villages and *jhuggi jhompri* (self-built hut) clusters (JJCs). I also spoke to local politicians and party workers across parties, water suppliers (tankers, bottles and tubewell networks), real estate dealers, health workers and non-governmental organisation (NGO) workers. In the Public Private Partnership project Zone I have had lengthy and detailed conversations with key members of project staff. I have also spoken to over fifty residents across the area's blocks, unauthorised colonies, urban villages, slums and *jhuggi jhompri* (self-built shelter) clusters (JJCs) as well as local politicians across parties, water suppliers (tankers, bottles and tubewell networks), real estate dealers, health workers and non-governmental (NGO) workers. For comparison I spent some time visiting and speaking to people in other sites similar to my primary research areas; unauthorised colonies, urban villages and JJCs at a comparable distance from the city centre and state border and with similar land values or water supply arrangements. I have also spoken with a large number of people active more at the city level than the community level, including DJB staff, politicians, academics, NGO workers, activists and other researchers. I spent some time volunteering with a local NGO

and become close friends with some political party volunteers, NGO workers, and other residents around my age.

Conversations and interviews took place in English and Hindi, but with low-income residents, and especially in Sangam Vihar, mainly in Hindi. I have been learning Hindi part-time since 2012 (three terms of evening classes at King University Modern Language Centre, ten weeks full-time training for forty hours a week, and around 200 hours private instruction at Zabaan in Delhi). I am able to have conversations with valuable study participants, such as water vendors or tanker drivers, who are unlikely to speak English, and follow meetings and lectures when required. I can also read and write Devanagari script, which allows me to read local press coverage – as well as being useful for text messages and emails.

I kept extensive fieldnotes, of which I have typed up 146, recording observations 'in the field' with dates, times and locations. Notes were also usually taken during interviews, in a mix of Hindi and English, except when the topic was sensitive. As I would often have many conversations in one day and was also recording observations I have numbered and referenced my fieldnotes and in text I refer to numbered fieldnotes (fnX), rather than interviews. Occasionally interviews were also recorded. I transcribed interviews and wrote up notes on the day, or the day after, they were conducted. I analysed transcripts for themes and specific topics as the work continued, and subsequently, in London, using nVivo 11. Recurrent ideas were identified and cross-referenced across study participants. Information from transcripts was then triangulated with data from academic, policy and media sources. Where my fieldnotes are used in the text I have made minor edits for style and ease of reading (for example expanding abbreviations), but speech is unedited. Where I have translated words or conversations from Hindi it is indicated. I have not reproduced the Hindi original speech unless a construction was noteworthy. Occasionally Hindi words are left in the original (such as *pradhan*, *kholnewala*, *jhuggi*) but are italicised in text and paraphrased in brackets. All names of local residents have been changed to anonymise interviewees. Names of politicians at Member of Legislative (State) Assembly (MLA) level or above are retained, as are the names of other academics, journalists and well-known activists. Consent was obtained for all interviews. In order to protect the identity of my interlocutors I have attempted to keep the identity of specific areas ambiguous also and

have changed the names of some neighbourhoods. All project information is kept securely with personal information confidential and anonymised.

Participant observation is useful to approach what people do, which may contrast with what they say (Burawoy 1992:2). Research participants may be reticent about revealing unofficial or socially undesirable practices. On the other hand, they may assume understandings of taken-for-granted ideas and practices, which would not be considered worth reporting. Some forms of knowledge may not be easily verbalised. Observation can in this way highlight context, complexity and mess as opposed to grand, universalising theory. In my earlier research on infrastructure reforms in India, for example, reforms were understood at a macro-level as neoliberalising tendencies however, in implementation locally the same reform projects turned out to be much more precarious and subject to capture by local coalitions and agendas. During this research, informal dimensions of water reform implementation were not easy to observe but they were discussed by participants, often in comments at the end of interviews. Some of the most productive of these came about through my extended presence at Municipal offices which allowed me to develop relationships across departments and through chance meetings. Municipal officials were circumspect, but sometimes very frank about gaps in implementation and reporting. A situation where processes were substantially different from the "paper truths" (Tarlo, 2003; cf A. Gupta, 2012, p. 42) was expressed by a number of interview participants. The official table of water price tariffs submitted to central government only included the lowest price band, for example "because the others would be too high [for Delhi to approve]". 50 per cent of municipal water costs went on giving 'free' water to slums, directly contradicting policy standards said to be 'mandatory' for release of funds. And so on. While the five week duration of this 2012 visit only allowed me to scratch the surface of informal processes it revealed enough to confirm solidly the hunches impossible to support from desk-based work and suggest directions for future research.

Ethnographic work requires intimate, face-to-face interaction with participants, using natural conversation as informal interviews. Typically it takes the form of an in-depth study of a single or small number of cases, although this has shifted recently in response to debates over 'globalisation', and the advent of 'multi-sited' ethnography (Marcus, 1995).

Attempting to 'follow the thing' took me to a variety of sites (agency head offices, local offices, pumping stations, tanker filling stations, illegal factories, distributors, local network managers, political offices, many people's homes, different neighbourhoods, NGO offices, etc) while still leaving some crucial elements of water production outside of my research scope (remote dams in the Himalayas, restricted access water treatment plants, and urban areas across state boundaries). In this research I have resisted the temptations to follow movements of expertise and experts between say Delhi, London and Paris.

As mentioned above, ethnographic research is a craft skill, perhaps like statistics or languages that must be developed in practice. Data collection is premised on building relationships, skilful conversations, and detailed note-taking. Interpretation requires sensitivity to the field as well as theory. Expertise is based on experience in context and aims to go beyond the conscious competency in application of basic rules (be open-minded, patient, observant but not intrusive, etc) to a more fluid proficiency. Flyvbjerg describes this process of case-study researchers becoming experts in their specific field as the development of 'fluid intelligence' yielding an intuitive sense of validity, plausible interpretations, and suggestions for research leads as well as sensitive responses and intuitive decision-making in complex and shifting circumstances (Flyvbjerg, 2001).

These 'ethnographically-informed' qualitative approaches *do* raise particular challenges. They are time and labour intensive, competence must be learned and developed, and obtaining good data and making insightful interpretations depends on skill, knowledge, creativity, and experience. Establishing the significance of findings beyond a single case is notoriously difficult. In an unfamiliar culture, the difficulties of 'participating' or 'understanding local points of view' are how we would recognise lack of familiarity – consequently an ethnographic approach cannot be 'applied' and must be learned for each new context (e.g. government offices, activist meetings). Ethnography is also not suited to questions such as the distribution of a phenomenon in a population ("what % of residents of area *x* 'use' informal water?"), the impact of an intervention on an outcome ("what has been the effect of the PPP on water supply service levels in the PPP area?"), or people's ideas on a specific topic they may not be familiar with ("what has been the effect of the PPP on water supply service levels?").

More problematically, Stacey draws attention to the elements of betrayal and moral conflict unavoidable in close ethnographic work with people over the medium term and using the form and content of those relationships as an object of research (Stacey, 1988). While ethnographic methods may appear to provide the possibility of more empathetic, respectful and participatory research – valuable for researchers in solidarity with their 'subjects' – Stacey argues, based on her own experiences of adopting an ethnographic approach, that this can also compound the deception and instrumentalism that are felt to be ethically objectionable. Stacey's model is feminist research, and it can be imagined that concerns around researcher positionality and power are amplified in research across location, class, race, gender, education and other dimensions of differential status.

There are clearly very real differences in life chances and access to resources between researchers and subjects, as well as the substantial differences *between* researchers based on nationality and gender. However, we might want to suspend judgement about the fragility of our research interlocutors. Power is contextual, and in the local contexts where I met most of my research 'participants' I had limited power (but considerable privilege). However, the promise of access to opportunities (for status, enrichment, career advancement, UK work visas) that I represented as a white UK national was also something that many more enthusiastic collaborators were clearly aware of. Some people I was working closely with would have made an excellent study in political / policy entrepreneurship, however I felt that using my friends (while accepting that the relationships already had elements of instrumentality on both sides) as the object of research was a line I was not comfortable crossing.

Ethnography obviously raises complex ethical questions, particularly around informed consent and anonymity. I practised *overt* observation/participation in any situation where an introduction is required (I. Cook, 2005, p. 175). Formal interviews in official or 'work' settings are likely to shape participant responses. During previous research in India I found that a formally written page of English text was able to raise reservations in previously willing participants remarkably quickly. For this reason verbal consent following an outline of the terms given in the written form was preferred. On meeting research participants I

introduced myself and outlined my work in English or Hindi as appropriate. I alternated word choice with context depending whether it was more useful to present 'status' (research / *shod* / *anusandhaan*) or inconsequence and lack of threat (studies / *padhai*). For example:

> I'm a student, from London. I'm interested in water in Delhi. My name is Matt Birkinshaw. Can we talk a bit for my research / studies?

I had a letter of introduction from the Geography Department at London School of Economics and letters of institutional affiliation in Delhi which were sometimes also required. I also had standardised written consent forms for use if formally required. A brief outline of research was also prepared in Hindi and English, and questionnaires were also prepared in Hindi (English ones were not needed).

Working with personally difficult characters, such as those whose views or actions are distasteful, introduces a further element of complexity. I have found Sen's studies of female Hindutva activists (Sen, 2004, 2007) and Gould's work as an 'embedded' critic with the World Bank (Gould, 2010) very interesting for reflecting on the complex ethical relationship towards research participants with whom one may strongly disagree (cf Goldman, 2005; Mosse, 2004; Wade, 2011). Again, these challenges were an issue experienced, if not well addressed, in previous work in India:

> I am trying to practice agnosticism for this research. Since I don't understand the situation very well there's not much point in taking a hard line like 'privatization is bad', 'corruption is bad', 'Hindu fundamentalism is bad', 'water theft is bad', or whatever. A) it could get in the way of figuring out what is going on and b) it could make talking to people a bit tricky! (Field notes, Maharashtra, 29/07/12)

Acknowledging differences in situation and motivation, I attempted to approach interviews as '*a conversation*' – in which understanding and positions were shared between discussants – rather than an extractive or proselytising exercise (Brinkmann & Kvale, 2015). I downplayed my relative privilege in various ways, not least through simple incompetence.

> "[Senior Politician] is water mafia" Prakhar says.

> At this point I ask, perhaps too eagerly, if I can record the conversation, which takes Prakhar back a bit but he agrees. Then I discover that I have not brought my recorder. I try and record it on my phone but the screen has broken, then the back falls off and I have to restart it. By this time Prakhar clearly thinks I am a clown.
>
> While I am turning my phone off and on Prakhar tries to explain with an example – "It's like Punjab" he says, "People bring things across the border to exploit the different tax rates".
>
> Despite (or because of) repeated requests to talk slowly and use simple language Prakhar insists on speaking very fast and loudly to the point where he is literally shouting at me across the desk! Maybe this is to 'help me' understand but I wish he would speak slowly and softly (*dhire / dhimmi*) as I ask instead of getting louder! Later when I am talking to Ravi, Ritesh is also shouting at people down the phone which makes it impossible to hear what Ravi is saying.
>
> Conversations with party workers, Sangam Vihar, 18/05/2015, Hindi and English, F81 – cf footnote seven above

To some extent, demonstrating my 'European naivety' and sympathising with officials, workers and users about the constraints of their situation allowed me to collect stories about the progress of water, or governance reforms, in the city. Becoming researcher *as* infrastructure; taking these stories with me as I travelled from site to site allowed multiple conversations, or at least situated corrections, to take place as narratives merged and clashed.

Semi-structured key informant interviews were a central research tool allowing me to investigate how water arrangements are constructed and the meanings and outcomes they have for people. As ideal formal interview conditions were not always possible (see above), I made use of informal conversations with study participants where appropriate. Very loosely structured interviews organised around a number of central themes were found most productive, allowing a greater degree of naturalness, adaptation to changing and unexpected circumstances, and a more sensitive negotiation of the interpersonal dynamics of the exchange than a more tightly scripted set of questions. Kvale and Brinkmann define an interview as "a conversation that has a structure and a purpose", an exchange of views and interpersonal interaction designed to elicit the interviewee's knowledge or perspective on a topic (Brinkmann & Kvale, 2015, p. 3). Interviewing enables the researcher to learn local understandings rather than imposing pre-defined categories and facilitates sensitive

exploration of complex issues. Research interviews, then, are not a neutral extraction of information, but a co-construction, between two participants. This requires sensitivity to the researcher's role, and the interviewee's interpretation of the interview situation. Feminist researchers suggests being open, friendly and collaborative with interview subjects (Valentine, 2005, p. 121), and to the extent that this is practical, it is something I practise. While I accept Oakley's argument about minimising the instrumentalising and hierarchical tendencies of research there are more awkward questions that must be responded to about the duplicity and betrayal that this approach also brings into consideration (Oakley, 1998; Stacey, 1988).

Interviews allow respondents to present their views in their own words. Qualitative interviewing, because it allows respondents greater ability to frame their own contributions to the study is useful in providing attention to voices and experiences which may have been under-represented in previous discussions. For example, while the voices of low-income girls and women are presented in policy and political discussions on water access, they do not have structural power and this may influence the way their voices are represented. In academic work, a focus on marginalised groups has led to the presentation of the situation of women and girls as almost a synecdoche of the problems of lack of water and sanitation. As women and girls suffer the daily pain, humiliation and fear caused by inadequate water supply this focus is absolutely necessary and there is much more work to be done (See e.g. Datta, 2012; Truelove, 2011). At the same time, the voices of informal water traders, brokers and low-level workers essential for the functioning (and dysfunction) of urban water networks in Indian cities are almost completely absent from academic and policy discussions of water supply.

My preferred option was to use informal interviews on initial contact, 'light structure' interviews as the ideal, and semi-structured with high-status, very busy, or 'less willing' participants. I am using 'status' here as relative not absolute, to include for example groups powerful locally. As Melissa Butcher observes, high status individuals in an expensive mall or corporate design office may be low status in a busy neighbourhood market – and vice versa (Butcher, 2010). Multiple conversations was again my preferred option, using an informal initial meeting to test the water and following up with another meeting to

interview if possible. Conducting an interview at a later meeting allows more chance to build rapport, as well as gain understanding. Face to face interviews are preferred as social cues and presentation of the interviewee are very important information sources. In my experience physical presence in a respondent's immediate environment (e.g. neighbourhood or office) is the gold standard for persuading people to make time to talk to you (even with introductions, shared interest). This is quite a widespread characteristic of life in India highly relevant to research work (Gandhi, 2013). This is based on my observations of processes in a number of mundane activities as well as protocol for meetings in Indian government offices, which could be described as a *darbar* (court), even occasionally a *darshan* (vision of a saint or god).

Critiques of interviews have focussed on an often de-contextualised, artificial interview setting. My intention was to interview respondents in a 'natural' location, such as their workplace, home or neighbourhood, and ideally more than one of these. Additionally, 'walking interviews' as practiced by Clark and Emmel offered some interesting advantages (potential for conversation away from colleagues, family; potential to use landscape features as prompts; more relaxed setting than 'formal' sit-down interview; public visibility of discussion with foreign researcher) and disadvantages (public visibility of discussion with foreign researcher; possibility / likelihood of people on street becoming involved in conversation; noise and other distractions; impossible to take notes or record) (Clark & Emmel, 2010).

Interviewing is generally time consuming / expensive, and requires careful preparation including travel arrangements, appropriate permissions, as well as writing-up notes and transcribing recordings. One area of concern to be aware of is the balance to maintain between encouraging contribution and appearing to share participant's views (leading to experimenter bias). With the accretion of data from interviews with multiple participants it may be possible to build models for common understandings of research topics. In practice, interviews are likely to yield data that is both unquestionably about the world (such as timings of water availability) and respondents' understandings of it (such as perceived reasons for low service levels) (Byrne & Seale, 2011, p. 212).

I was not planning to make intentional use of group interviews. However, as Oscar Lewis observes below, there is a strong tendency in India, that discussions in public or semi-public places (e.g. anywhere that is not a formal office with a closed door – and actually quite often there too) become group discussions. I used group discussion with residents, agency staff and political workers several times, and found them useful, in a general way.

> 'Most of these [interview] sessions were group sessions as much by necessity as by design, since we found it almost impossible to hold a private interview without neighbours and relatives dropping in . This situation must be kept in mind by any student from the West who takes privacy for granted…' (Lewis, 1965, p. x)

Group interviews, or 'focus groups', have the benefit of efficiency and allow access to a wide range of respondents at once, thus increasing the amount and range of data accessible within a given timeframe. The format also has the advantages of accessibility, as focus groups: 'do not discriminate against people who cannot read or write and they can encourage participation from people reluctant to be interviewed on their own or who feel they have nothing to say' (Kitzinger, 1995, p. 299). These last two points (reluctance, reticence) are an area where focus groups would be intuitively valuable for my research. In fact, given prevailing gender norms in North India, it could be inappropriate for a male foreign stranger to be alone with a woman as might be expected in an interview setting. These cultural strictures are reduced in more westernised/modernised contexts (such as NGO or academic settings) but are still prevalent.

However, in group discussions, in addition to the contributory influence of the researcher, interpersonal dynamics among the group can shape the content, censuring outlying opinions or unlikely assertions. Thus people may present a more socially acceptable version of their thoughts, power differentials within the group may shape discussion strongly, some participants may dominate discussion and individual views which may be marginalised or silenced are hard to follow up. Maintaining confidentiality can be a problem. This majoritarianism has both helpful and unhelpful effects. Group dynamics may help focus discussion on issues of shared importance, and the corroboration of views is readily observable. Respondents comment in their own words and can be prompted to speak by others in the group. As noted above this may help in accessing the experiences of those

who would not otherwise be interviewed. Depending on the topic, a group interview might provide a less (or more) threatening environment to discuss an issue. Participants may even enjoy the discussion and shared discussion has been argued to be empowering (Freire, 1996) although the reverse is also possible (Freeman, 2013). Handling the situation sensitively to facilitate discussion and support participants however requires skill and experience as well as the trust of participants. With a small number of residents, a group discussion could be a useful way to get a sense of the diversity of situations as well as shared understandings, such as the difficulty of making complaints over poor service to the *kholnewala* / *pradhan* (see *Chapter Five*, page 155pp.).

I this research, class differences were a noticeable problem in group discussions. People with lower incomes or lower levels of water access were sometimes unwilling to speak, giving a sense that the others in the group did not agree with the speaker but were unwilling to contradict them. Individuals that expressed points of view the group as a whole was not willing to share – like the young girl who said she had tried to join a committee meeting but had been chased away – were also quietened by the group. Facilitation is a key challenge for group interviews, requiring considerable experience, cultural awareness and tact – as well as linguistic fluency obviously. Although I have some experience in facilitating group discussions in a range of contexts, the above qualities are not ones which I currently possess to a high degree. For this reason, group interviews were a method used infrequently and sometimes more by chance than design.

LIMITATIONS

This research project studies the process of domestic water provision. It does not primarily analyse industrial, commercial, institutional supply and consumption or the use by public agencies, although these all do impact water availability for domestic use.

My research sites are within south Delhi. Water supply in the north of the city differs, as it does across state borders in parts of the National Capital Region such as Gurgaon, Faridabad and Ghaziabad. The situation in areas of Delhi-NCR (like those named above) which fall under different state governments, although more interesting was excluded as introducing

unnecessary levels of complexity. The thesis should make the case for specificity across different urban scales and locations and therefore generalisation to other Indian cities is not my intention. While there may well be points of similarity these could only be taken as tentative hypothesis to guide further empirical research.

As the earlier excerpt illustrates, despite concerted and regular effort over a number of years (two hours a week minimum in Delhi, usually five, and ten weeks forty hours a week full-time), my limited Hindi was a limitation to this research in some ways. It took at least six months before I was able to conduct research interviews and conversations in Hindi. I paid friends for assistance with language twice – to interview an older man, a traditional water carrier, who spoke an accented and very 'high' Urdu, and to interview a tanker owner – for the Urdu, interpretation was necessary, for the tanker owner, it did not add much (although I learnt some interesting things about water in Dwarka from my friend). On a number of occasions I did research with Hindi-speaking friends ('Aasha', 'Sanjay' and Juli Perczel) which meant that I could check points which were unclear to me at a later date. However, I was reluctant to hire a research assistant / interpreter for a number of reasons. First, because of the increased rigidity this would impose on research scheduling and timings. Second, because I appreciated the ability to interact with people on my own as an alien to their social context, and suspect that working with other people (foreign or local) would allow my interlocutors to 'place' us in ways that might restrict my freedom to create interactions with them. Third, working on my own forced me to develop my Hindi in ways that I would not have done otherwise. Relatedly, I have noticed that interpreters not only play a major role in steering conversations and interactions but also may gloss, embellish or omit details of what is being said. Lastly, the content of my conversations (water supply and control) was primarily quite straightforward and therefore possible with a nascent Hindi vocabulary, which would certainly not be the case had I been researching people's understanding of religion or poetry.

The challenges of accessing state and private sector providers involved in a politically, and sometimes legally sensitive, process has limited the extent of comparative work I was able to undertake. Other researchers have also found accessing informal water suppliers a challenge (Borthakur, 2015; Kacker & Joshi, 2016). The timings of fieldwork, much of which

took place after the resignation of the first AAP government and before their re-election, also limited the amount of research on the Aam Aadmi Party that I was able to conduct. A comparative study of changes under the AAP in south and west Delhi (where there is also a PPP with a multinational company and large areas of unauthorised colonies) would make an excellent future project.

Skin tone in India is a marker of social prestige – and this also applies to foreigners. In India and Pakistan I was mistaken for 'local outsider' several times (Kashmiri, Gilgit, Khyber) mainly by speaking passable Hindi and being comfortable in areas where westerners are rarely seen. Many people also thought I was French (smarter clothes than Brits are perceived to wear) or American (shaved head). While my pale complexion does make me stand-out, it also facilitates interactions with people in a way that an Indian, or African, appearance would not. In discussions with people over their perceptions towards foreigners, dress was a key marker of 'respectability'. Consequently I sported jeans or smart casual clothes in the summer heat in order to avoid being treated as 'dirty' ('*gande*') 'Euro-trash' or more colloquially, a '*Paharganj-wale*' ('backpacker'). This had the effect of positioning me as 'rich' ('*paise-wale log*') instead, a marginal improvement, which could be mitigated somewhat by doing things that rich people do not, such as living cheaply in a village, walking, drinking unfiltered water, smoking leaf cigarettes (*bidi*), eating in *dhabas*, etc.

Having English (as opposed to Irish, French or Armenian) nationality is from previous experience a mixed blessing in contemporary India. While some individuals seem to be unusually friendly on this account, most reactions are negative or indifferent. Nationalist imaginations and the independence struggle are still strongly resonant in India, and Delhi has been a key site in both. The massacres of 1857 being a key event (King, 1976, p. 210; N. Gupta, 1971, p. 62). (N. Gupta, 1971, p. 62). Consequently, I mentioned my Armenian-Irish heritage if possible. Armenians have been a familiar, if minor, presence in the subcontinent for hundreds of years, and the 'Armenian connection' was generally well-received. Disclosure of English nationality on the other hand was usually met with an awkward silence and change of subject.

The not unreasonable perception that I was some kind of *jasoos* or spy who had come to India to write about how dirty it was appeared to be fairly widespread. On my first meeting at the Delhi Jal Board headquarters I was shown from one official to another ('I've got a British National in my office – do you want to talk to him?') before eventually being left to my own devices for several hours in a run-down waiting room. Subsequent visits proved only slightly less rewarding. With considerable perseverance I did manage to find out some things about water in Delhi, but not always from the places that I expected to.

CONCLUSIONS

An interest in the ways that ideas move and change led me to work on reform projects. From my reading and previous experience, it seemed that the relationships of reforms with informal practices was an area of potential importance that had not been over-explored. Delhi as a city with multiple water reform initiatives underway and a high level of informal groundwater use in a Hindi-speaking region provided a convenient site. Delhi itself provides an extreme case, given higher than average incomes and political salience. As south Delhi has poor water supply, two of the three PPP projects and high levels of inequality I concentrated my research here. Urban villages and unauthorised colonies were areas largely dependent on informal means of various kinds to access water, yet underrepresented in the literature which has tended to focus on slums and elite informality. Previous research showed me the value of comparisons across sites for perspective and consequently I used unauthorised colonies in two main areas (Sangam Vihar and Malviya Nagar) as primary research sites with additional research in similarly located areas (Chhattarpur, Kailash Colony) and for additional background comparison. I used Sangam Vihar as an extreme case of informal water access because the area was not, at the time, supplied piped water from the government. Malviya Nagar was used to examine PPP project implementation in a mixed income area. Because of the potential sensitivity of the issue, I adopted 'ethnographically informed' qualitative methods, primarily key stakeholder interviews and observations to gather data. Developing Hindi language skills and access to organisational informants from the DJB, PPP and informal water suppliers was a challenge and delayed my research timetable.

Delhi's hydrology is complex. Delhi's Water Board itself *cannot* know where water is going, or how much is being paid for it (*Chapter Four: Government Water*). As we'll see towards the end of the thesis, a multi-national company with professional staff, extensive budget and statutory authority has struggled over several years to understand water distribution in one neighbourhood of Delhi. Shifting to a smaller scale within this neighbourhood, we'll meet Hafiz, the muscular and entrepreneurial Residents Welfare Association (RWA) president – and learn how even within one small urban village a multitude of physical systems and relationships of control and patronage exist. We'll investigate water supply in unauthorised colonies with Aasha, Tej and others, and see how from one lane to another the water quality, timings and relationships of users to suppliers vary. All claims to know or understand this system are therefore necessarily partial and provisional.

The next three chapters describe my understanding of government piped water, 'off-grid' non-piped supply (both government and local private sector) and piped network under a PPP reform project. First, as it forms the background on to which subsequent chapters add additional layers of complexity, I discuss the 'twilight zones' of government water.

CHAPTER 4.

GOVERNMENT WATER: TWILIGHT ZONES

This chapter builds an argument in response to the question of how Delhi's public water supply is governed, and why it appears to be so uneven and unreliable. The core claim is that the 'formal' system of government supply through the public network is already informalised in several ways. A simple binary understanding of formal and informal water systems is therefore unlikely to be helpful. Further, informalities within government water supply differ from each other substantially, making it hard to treat 'urban informality' or 'informal water' as a homogenous category. It should be apparent that this is very much a situation in flux and that Delhi's water supply is subject to constant, and changing, attempts at improvement.

I make several points. I note that despite being explicitly set-up as a move towards privatisation of water supply in the city, the Delhi Jal Board (DJB) has been slow to implement commercialisation reforms. This suggests the political salience of water and the challenges of policy transfer across sites which we return to in *Chapter Seven*. The unevenness of water supply across different areas of Delhi is compounded by an inability to correlate water and revenue following an increased number of revenue zones in 2003. This makes it hard to measure the efficiency of water management and revenue collection. As the water distribution is not accurately measureable, it is impossible to say how much water is lost to leaks or non-payment. Areas of the city with different planning status are allocated different quantities of water through different supply modes. The actuality of water supply however can vary widely within, and beyond, these norms as a result of formal and informal negotiations. Provision of water from the DJB appears susceptible to 'informal' influence over both physical and administrative processes, at a range of scales. The network has been physically modified in many ways, including unauthorised changes to the piped network and ubiquitous private household infrastructures such as pumps, tanks and filters. In closing, I note that administrative informalities include exceptions at a range of scales as a result of lobbying by politicians and neighbourhood groups; at a city-level tariffs are low, at a

neighbourhood level there are ad hoc adjustments, at household level bills may be waived through arrangements with meter readers.

The chapter is comprised of four sections: a brief history of the Delhi Jal Board; an outline of the challenges of obtaining knowledge of Delhi's water flows; a discussion of the personalised infrastructures produced in response to unreliable supply; illustration of the role of intercession in obtaining improved water access.

DELHI JAL BOARD, ESTABLISHED 1998

The formation of the DJB and efforts to bring private sector investment and efficiency into Delhi's water are closely related. In 1997, the Approach Paper for the Ninth Five-Year Plan strongly recommended regulatory change to create a conducive environment for private sector participation and investment in water, this included full cost recovery, the removal of 'excessive' cross-subsidization from other sectors and that any subsidies for low-income groups be transparent, selective and targeted (Pitman, 2002, p. 7 cf Sangameswaran's (2014) description of similar conditions for World Bank water sector lending to Maharashtra). In the same year, World Bank officials in Delhi suggested that some leftover project funds be used to appoint a consultant to look into Bombay's water management (Björkman, 2015, p. 29).

In early 1998, the finishing touches were being put on a review conducted by the World Bank on India's progress in water sector reforms since 1991, the date of India's economic liberalisation and the Bank's last major review of the water sector. Meetings in Delhi between officials and Bank staff led the formation of a set of reforms for the water sector, an 'agenda', aimed at 'unbundling' and recognising the challenges posed by 'political will and commitment' to 'the Bank's dialogue on water reform'. These discussions included plans for a project in Delhi (Avjeet Singh, 2008, p. 88).

> Under the 1998 reform agenda, institutions and practices that have remained unchanged for decades are to be tackled and changed quickly – an approach to institutional reforms that flies in the face of institutional realities and the political will such as they exist in India today. (Pitman, 2002, p. 9)

In March 1998, world leaders met in Paris for the three days before World Water Day (March 22nd) for the International Conference on "Water and Sustainable Development". This was intended to build on previous international meetings at Mar del Plata (1977), New Delhi (1990), Dublin (1992) (Europe Environment, 1998). In April, a month after the 1998 Conference, in line with the Bank's proposals for water reforms and unbundling, the Delhi government announced the move to transfer responsibility for Delhi's water and sewage to the Delhi Water Board. At the time, the Delhi government was spending ₹2 billion (£50 million) yearly on water supply, while collecting ₹1.1 billion (£27.5 million). The utility was massively in debt with ₹14.44 billion (£358.2 million) outstanding. London's Financial Times observed that 'politics prevents any attempt at tariff reform'. Delhi elections were looming, and the BJP government were in no mood to risk defeat, especially since at a national level they were leading a coalition. Consequently tariff increases were 'out of the question' (Financial Times, 1998a).

In May 1998, the BJP controlled Delhi government passed the Delhi Jal Board Act. This created the Delhi Jal Board as a corporate structure to manage Delhi's water. The DJB was nominally separate from the State Government and the Municipal Government, but still headed by Delhi's Chief Minister (CM), the most senior politician in the Delhi State Government. This was an important limit to the organisation's autonomy from political pressures. By August of 1998, the Delhi CM announced that they were 'on the verge' of a ₹16.25 billion (£386.9 million) loan for upgrades to Delhi's water system (Financial Times, 1998b). India is the World Bank's largest client and their third largest client for water sector lending (World Bank, 2016a, 2016b). The World Bank gave the loan for privatisation of Delhi's water, and the DJB opened a tender for consultants to advise on the project (Daruwala & Nayak, 2008, p. 96; Ramesh, 2005).

Curiously, before the DJB was formed, in 1997, Delhi's water supply indicators seem to have been on a par with the other metro cities (Ruet, Zerah, & Saravanan, 2009, p. 12). Consider the table below. While hours of water availability per day had halved since 1992, in 1997, Delhi's performance was similar to two of the three other metro cities across all indicators. Ten years later, system performance indicators for network coverage, timings, quality and

non-revenue water are at the bottom end of a survey of seven of India's major cities (Shaban & Sharma, 2007).

Table 2. Service levels Mumbai, Calcutta, Delhi, Chennai 1992, 1997 (Ruet et al 2009, p. 12) [darker shades indicate lower service levels]

	Mumbai		**Calcutta**		**Delhi**		**Chennai**	
Service Indicators	**1991**	**1997**	**1992**	**1997**	**1992**	**1997**	**1991**	**1997**
Service Coverage (in %)	N.A.	100	64	66	69	86	48	97
Water Availability (in hours per day)	5	5	10	10	7	3.5	3	4
Average Tariff (₹ per metre^3)	2.1	2.7	1.5	0.5	1.4	1.6	N.A.	11.4
Efficiency Indicators								
Unaccounted Water (%)	24	18	36	50	30	26	N.A.	20
Unit Production Cost (₹ per metre^3)	1.1	2.4	1	1.2	0.6	1.7	2.9	8.5
Operating Ratio	0.6	1.08	1.11	5.25	0.81	1.48	1.57	0.94
Accounts Receivable (months)	2.5	19.7	2	1.5	NA	4.5	9.5	5.8
Staff per 1000 Connection	61	33.3	16.2	17.1	8.9	21.4	38.7	25.9
Average Operating & Maintenance cost per person (₹)	90.3	1358	84.3	25	98.8	355	85.9	675

The formation of the DJB was precisely the move towards a less politicised institutional environment that the Bank had been advocating as an incentive to private sector investment. At this time, parastatal management of water supply was limited, in most cases[27], to towns which were already under a corporate governance structure, such as Navi Bombay (see Shaw, 2004) and Jamshedpur (Asian Development Bank & Lee Kuan Yew School of Public Policy, 2010). Of the other five metro cities in India, water in Kolkata and Mumbai is still supplied by the Municipal Corporation, while Bengaluru and Chennai have a parastatal Water Authority similar to Delhi. Public-Private Partnerships were introduced for Delhi's water supply in 2012 (discussed in *Chapter Six*). This transition in Delhi anticipated the policy trajectory towards parastatal management and implementation agencies, which has become much more widespread since urban policy changes under the 2005 Jawaharlal Nehru National Urban Renewal Mission (JNNURM) and further increased in the 2014 Smart Cities Mission, which mandates the creation of Special Purpose Vehicle's for project implementation.

[27] With the exception of Tirrupur, an early, and unsuccessful Public-Private Partnership (PPP) project (Mahalingam, Devkar, & Kalidindi, 2011).

Physical losses compounded by low levels of billing, collection and overall revenues contribute to the DJB's financial difficulties. Despite being a parastatal, the DJB has been reported as dependent on government for 3.8 billion rupees in 2009-10 and over 2.5 billion rupees losses from unpaid bills in 2012 (Bagga, 2012; Ramachandran, 2013). As the national capital, political pressure to keep water bills low in Delhi is particularly effective. Water charge recovery rates at 30% are fairly low against an all-India average of 60% (Jain, 2012). Before tariffs rose in 2004, Delhi was said to have the lowest water charges of all Indian metro cities and was spending 2.5 billion rupees more than its revenue (Delhi Jal Board, 2004c, p. 4; Avjeet Singh, 2008, p. 420). The Chief Minister at the time, Sheila Dikshit, 'attributed the low tariffs in Delhi to the cultural mindset of not feeling the need to pay for water as well as political interference to some extent' (Delhi Jal Board, 2004b, p. 23). Indeed, tariffs around ten times below operation and maintenance costs seems to be characteristic of many South Asian water utilities (Brocklehurst, Pandurangi, & Ramanathan, 2002, pp. 4–5). At a flat rate, low tariffs function as regressive subsidies by allowing higher volume users to pay proportionally less per unit. In Delhi's case, this revenue deficit 'is funded through loans from Government (accumulated debt ~Rs [₹] 5100 crores[28])' (Delhi Jal Board, 2004c, p. 4).

'Rationalising' low water tariffs which reflect 'political interference' is a key objective of efficiency reforms. However, in many cases of water privatisation, tariff rises have caused the contract to be cancelled. The World Bank suggests that government which are planning to involve private sector in their water service raise tariffs prior to handover of work so as not to burden the private sector player with public dissatisfaction over rising charges. For example, after the introduction of private sector management at Nagpur and Mysore there were protests as tariff rises were too high and the state / municipal government ended up paying to bail out the private sector. In Delhi, following World Bank best practice, the government raised water tariffs before introducing the private sector (Kapur, 2015, p. 2). DJB tariffs were revised in 2010 after a tariff survey by Global Water Intelligence. Tariffs are now scheduled to rise at 10% per year, and the policy is fixed for the next thirty years.

[28] A crore is ten million

There has been some criticism of the 10% p.a. price rise as not relating to the cost structure of production, supply and management. However, the DJB credits the rise with being able to balance its books and reduce reliance on government support (Ramachandran, 2013).

In the 2014 Delhi government elections, the cost of living in Delhi (electricity, water, inflation) was a central element of opposition rhetoric which I heard in campaign speeches from Kejriwal and other Aam Aadmi Party (AAP) candidates. Discontent over tariff rises led to an unexpected landslide win for a new political party headed by one of the main campaigners against Delhi water privatisation. Delhi's election commissioner suggested that the water tariff increase under the Congress government was a factor in their electoral loss. It seems possible that dissatisfaction with water privatisation in this case was a factor leading to a change of government and not cancellation of the project.

UNKNOWN LOSSES

As one of India's largest and most politically powerful cities, Delhi's water network extends hundreds of kilometres beyond its boundaries. Despite having the highest per capital water supply in India – 237 litres per capita per day (lpcd) close to the United States average (UNESCO, 2014, p. 63) – there is a persistent discourse of 'not enough water' particularly from the water board (e.g. Ghosal & Ashok, 2017; Halder, 2017b). The city's substantial use of groundwater, a suboptimal solution, indicates that this is not just empty rhetoric. This presents something of a puzzle. The obvious question, being raised (since fieldwork concluded) by the Chief Minister and the Delhi Jal Board Chief Executive Officer (CEO), is whether the DJB is pouring water into a leaking bucket (Firstpost, 2017).

Aggregate water demand, and supply, in Delhi has been rising steadily. At the time of writing, the utility supplies 900 million gallons a day (MGD) of water, up from 835in 2014 (Delhi Jal Board, 2015). Water demand is likely to increase further in future as a function of population increase (Kundu, 2009b; Sivaramakrishnan et al., 2007) and rising incomes (Kundu, 2009a; Kundu & Saraswati, 2016). Delhi today draws bulk water from an ever increasing number of damns in the Himalaya with construction on the latest, Renuka, ongoing. Bulk water to the city from these dams is processed in Delhi's water treatment

plants (WTP). Two new WTPs were added in 2015, giving a total of nine in 2016 with capacity of 820 MGD. At time of writing, DJB is building a new 105MGD WTP at Chandrawal with Japanese development assistance and a 135 WTP at Wazirabad (Delhi Jal Board, 2015). An extra 80 million litres a day (MLD) is sourced from groundwater.

From treatment plants, water is pumped to Underground Service Reservoirs (UGR) for temporary holding and then from there to consumers. As bulk water release in primary distribution can be uneven, these zonal UGRs are used to store between one and three day's supply. Collecting the water at this intermediary point allows irregular flow quantity and pressure to be moderated[29]. There are 117 UGRs across the city and new UGRs are being built (Delhi Jal Board, 2016a)[30]. These three stages of the water network have been mapped with geographic information systems (GIS) at DelhiGeoSpatial, however the information is from some years ago and not updated. The DJB has started to acknowledge a responsibility to address inequalities in water provision to different areas of the city. One means of doing this is the construction of more underground service reservoirs (UGRs). The Summer Action Plan 2015 notes that attempts are underway to equalise the quantity of water supplied to the different UGRs across the city. There are less UGRs in the south of the city and building new ones will allow water to be stored closer to under-served areas[31], while in the past, water might have run short before reaching them.

There is also a final, and more problematic, stage of the distribution network, self-laid consumer connections – most often in unplanned, or unsupplied areas (see section below). For example, the Residents Welfare Association (RWA) president of a Muslim majority urban village drew a map for me (see diagram below). The area nearest the road gets mains supply. The top right area near to the neighbouring Hindu area get supply from a tube well. The top left area has to 'make do' and, at best, uses self-laid 'spaghetti' pipes to the other connections. These 'lane' (*gali*) networks may run on groundwater or illegal connections to piped supply (Tovey, 2002).

[29] Personal communication, Delhi Jal Board official, DJB Planning, DJB HQ, 10/04/15, fieldnote 52 (fnX subsequently); Personal communication, project manager, PPP offices, Delhi, 21/04/15, fn56
[30] Personal communication, Delhi Jal Board official, DJB Planning, DJB HQ, 10/04/15, fn52
[31] Personal communication, executive (mid 30s, male) at Delhi Geospatial, 24/09/14, fn50

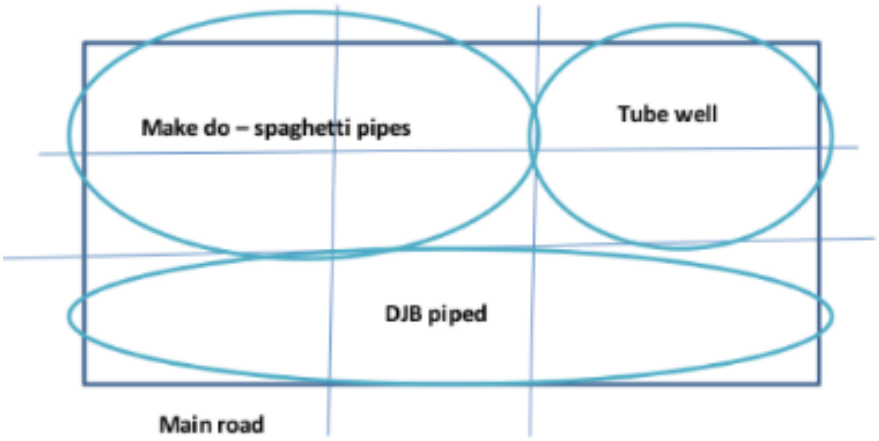


Illustration of water supply in urban village (Muslim), South Delhi (Personal communication, RWA President, urban village (Muslim), South Delhi, 10 March 2015, fieldnote 28)

At the time of research, 'quantity is the issue' remained the official line from the DJB on Delhi's water issues[32], meaning that the quantity of bulk water coming in is insufficient and issues with water supply can be solved by increasing bulk water, which is simply 'a matter of time'[33]. Two solutions for increasing bulk inputs to the network are proposed: developing additional large dams in the Himalaya and to a lesser extent by acquiring more water from the Yamuna in Haryana via the Munak Canal. At time of writing the focus on large dams has been changing too, the cost of dam projects has recently been argued by the DJB CEO as an incentive to focus on more efficient supply through public-private partnerships (Keshav Chandra, 2017; on the inefficiency of big dams see Ansar, Flyvbjerg, Budzier, & Lunn, 2014).

However, historically, the rhetorical focus on insufficient bulk water supply displaces the apparent inequality of distribution within the city. The similar construction of a natural problem of scarcity which works to obscure the politics of water distribution has been observed and critiqued in Gujarat (L. Mehta, 2001, 2007). In Delhi, it is noticeable that the peripheral areas get limited supply. The map below (Figure 15, page 111) appears to show that the Cantonment area receives 509 litres lpcd on average, New Delhi Municipal Corporation area 462lpcd, while Mehrauli, in the south, gets just 29lpcd and Narela at the northern edge gets 31lpcd. Recalling the earlier mention of patterns of urbanisation in Delhi and India, it seems likely that this is because population in these areas has grown much

[32] Expert roundtable on innovation in water and sanitation services, Development Alternatives, November 2014, Chatham House rules, fn38
[33] Personal communication, Chief Engineer, Planning, DJB offices, Jhandewalan, 10/04/15, fn51

faster than the ability of the water utility to provide for it. India's chief auditor re-affirms this state of unequal distribution:

> The drinking water was not being distributed equitably amongst the population due to lack of reliable data on population and water supplied to different areas. Further, 24.8 per cent of the households in Delhi were being supplied water through tankers in the absence of pipe lines where the average per capita supply was 3.82 litres per day against a prescribed norm of 172 litres. Metering of water at consumer end was not comprehensive due to which, less than 40 per cent of water produced was billed during last three years (Comptroller and Auditor General, 2009, p. 5).

It seems that data on Delhi's water distribution is not only not available but not easy to systematically collect. In a recent video from the Delhi Water Minister, Kapil Mishra, the DJB CEO, Keshav Chandra, explains that the DJB call centre is used to determine which areas are getting less water through the volume of complaints received. Mishra quickly takes the microphone back after Chandra makes this statement (Kapil Mishra, 2016) (cf page 218-219 where the PPP manager says the same thing).

Technology and expertise are not absent however. In addition to the GIS mapping, Delhi has been divided into Demand Management Zones as a distribution tool. Demand Management Zones are a technique first used in the UK with the intention of making water supply easier to track and measure. In Delhi, however, they have had the opposite effect. Before 2003, Delhi was divided into 12 distribution zones, and since then has been divided into 21. The zones are used to ration distribution, and are sub-zoned, these smaller zones being operated by means of valves in the network. Each zone has dedicated UGRs. Unfortunately, 'the zones operate as maintenance and revenue collection zones, the boundaries of which do not coincide with the physical supply boundaries' (PriceWaterHouseCoopers, DHN, & TCE, 2005, p. 11). As zones are not hydraulic units, data on the quantity of water supplied to different areas and revenue recovered would be impossible to calculate. As PriceWaterHouseCoopers (PWC) noted '[Zones] need to be revised so that water supplied can be correlated with water consumed and revenue' (PriceWaterHouseCoopers et al., 2005, p. 20).

The Comptroller Auditor General, India's highly respected national auditor seems baffled by the complexity of Delhi's water supply arrangements, describing the zoning arrangements as 'irrational'. While pumping water to UGRs and distribution lines is managed by nine Engineering and Maintenance (E&M) divisions, distribution lines are managed by 22 Civil divisions. Allocation of areas among division is on the basis of MLA Constituencies, and each division has at least two constituencies. E&M divisions receive water from more than one WTP and supply to more than one Civil division. Civil divisions also receive water from more than one E&M division. Water from one UGR may be supplied to more than one Civil division. A single distribution line may also cover two Civil divisions… This makes it very difficult to track the flow of water. This state-instituted opacity appears to support the idea of informality as a state-led technique of deregulation (Roy, 2009b).

> 'In this scenario, water supplied to each division is not measurable making proper management and distribution of available potable water ineffective and inefficient respectively. Due to the complicated system of distribution, water is not supplied to divisions according to the population of the area under their jurisdiction. As such, the present allocation of distribution work amongst various divisions is not conducive to efficient water management and equitable distribution of potable water to the populations of Delhi. A proper distribution of jurisdictional areas will also aid in making individual civil division accountable for water received, distributed, distribution loss, non-revenue water, etc.' (Comptroller and Auditor General, 2013, p. 88).

The map on page 110 below[34], is the earliest example I have found of a map which is widely reproduced and cited (e.g. Biswas, 2015, p. 133). Arvind Kejriwal, before becoming Chief Minister states that the DJB CEO told him that the figures used for the map were calculated provisionally on the basis of the time that distribution pumps were running (BharatKiAwaaz, 2007 at 17:38 minutes). The map uses the 12 pre-2003 zones. It was replicated without amendment (or citation) in the Centre for Science and Environment (CSE) two volume study of water supply in Indian cities (Narain, 2011). CSE staff have told me that a great deal of time, effort and expense went into the study. The absence of more recent figures suggests that accurate data on the supply of water to different areas is hard to come by.

[34] http://ncrpb.nic.in/pdf_files/Delhi_Fact_Sheet1999.pdf; Reproduction available at https://cdn.downtoearth.org.in/dte/userfiles/images/0000025369-inequity%20chart.jpg

Zonal water supply in Delhi in 1999 (litres per capital per day)

'Levels of Water Supply in Delhi', data from DJB and National Capital Region Planning Board. Originally captioned 'Delhi Master Plan Norms 363 LPCD' (National Capital Region Planning Board, 1999, p. 36).

The DJB's 2016 Draft Water Policy also supports my arguments about the limited knowledge of water supply in the city. It states that 'absence of a comprehensive database is an obstacle to policy making', and specifies: 'spatio-sectoral data of consumption at macro-levels *does not inspire confidence* and is *unavailable* at district level limiting scope for analysis and generation of options', 'the same is true of groundwater database', 'monitoring of flows and discharges: this is neither available by sector or zone, neither for water supply nor for sewage nor for stormwater discharges' (Delhi Jal Board, 2016b, p. 9).

In addition to the difficulties of tracking distribution, the supply figures (e.g. 900 MGD etc) given for Delhi's water network above are 'pre-loss'. This means that after accounting for the water lost in the transmission and distribution pipes, the net supply is lower still. Delhi is a large city with a 9,000km network of pipes dating from the 1890s (Narain, 2011). In Delhi, as is common in developing countries, exact figures are hard to calculate due to the non-correspondence of revenue and hydraulic zones mentioned, and in the absence of comprehensive bulk and user metering (Frauendorfer & Liemberger, 2010, p. 5). Some level of loss is normal in all water systems, particularly those, like Delhi, with larger networks and older pipes.

Using data from over 900 utilities in 44 developing countries, the International Benchmarking Network for Water and Sanitation Utilities (a World Bank database) found average Non-Revenue Water (NRW) levels in developing countries of around 35% (Kingdom, Liemberger, & Marin, 2006, p. 2). The Indian Ministry of Urban Development Service Level Benchmark for NRW is 15% (Ministry of Urban Development, 2016). Estimates of water lost in Delhi vary between 20 and 70%. Different sources, including official sources, state high losses of water during transmission (JNNURM 2005, Daga 2004, Srivastav 2006) and (Alankar, 2009, pp. 179–186; Biswas, 2015, pp. 130–132). For zones South II and South III (where one of the city's PPP projects is sited) estimates of NRW vary more widely across agencies: DJB gives 28%, PWC 48% and GKW 59% (Biswas, 2015). Comptroller Auditor General gives non-revenue water for 2009-10, 2010-11, 2011-12 as 66.97%, 64.80% and 62.59% respectively (Comptroller and Auditor General, 2013, p. 93). The PPP contract for Malviya Nagar places the figure higher still at 65-70% (Delhi Jal Board, 2012, p. 1989).

Augustin Maria's work suggests that the gap between water supply and demand (of, he argues around 50%) is made up through unregulated groundwater use (Maria, 2008). DJB itself in a 2004 presentation stated that: 'real losses are around 40% of water produced' and that 'Private supplies, mostly through tubewells, meet the DJB supply shortfall' (Delhi Jal Board, 2004a, p. 2, slide 7). Professor Gosain, at the Indian Institute of Technology in Delhi, also supported the idea that the gap between water demand and supply is made up by groundwater. He told me that his research in North India shows that rivers themselves are losing water due to groundwater extraction (Moors et al., 2011; Narula & Gosain, 2013). Recent research on groundwater does report a very high water table in north Delhi, although reports from the Central Ground Water Board and other agencies show falling ground water across the city as a whole, especially in the south (Shekhar, Mao, & Imchen, 2015).

However, in the wake of the controversy over Delhi's proposed water privatisation in 2004-5, the high loss figures have met with scepticism from several quarters. A common argument, made by Kejriwal (InKhabar, 2013; IPTsecretariat, 2007), Dunu Roy[35] and others,

[35] Personal communication, Dunu Roy, south Delhi, 21/08/14, fn4

is that losses are inflated. Aman Sethi, a journalist and author, told me that transmission losses would be estimated by the DJB at around 20%, 'because 60% of 800MLD cannot be leaking without raising the water table'[36]. Very roughly, this would mean about 13 litres of water an hour leaking across every square meter of Delhi; this is around *forty times* higher than peak average monsoon rainfall.

A different explanation for the overly-high water loss figures could be that they are based on a misunderstanding of Non-Revenue Water (NRW) and Unaccounted-For Water (UFW). UFW is 'lost', for example through leaks. NRW is all water that is not paid for, through leaks, theft, 'free supply' (in response to political considerations – see Chapter 4), or non-payment of bills. Commenting on this widespread confusion, we can distinguish three categories:

- unbilled authorised consumption (including water used for utility operations, provided for free to other agencies and consumer groups)
- commercial losses (including unmetered water, data errors and theft)
- physical losses (including leaks and reservoir overflows) (Frauendorfer & Liemberger, 2010, pp. 5–6)

Table 3. Water balance showing NRW components

Water balance showing NRW components (Farley, Wyeth, Ghazali, Istandar, & Singh, 2008, p. 10)

System Input Volume	Authorised Consumption	Billed Authorised Consumption	Billed Metered Consumption	Revenue Water
			Billed Unmetered Consumption	
		Unbilled Authorised Consumption	Unbilled Metered Consumption	Non-Revenue Water
			Unbilled Unmetered Consumption	
	Water Losses	Commercial Losses	Unauthorised Consumption	
			Customer Meter Inaccuracies and Data Handling Errors	
		Physical Losses ('Unaccounted for water')	Leakage on Transmission and Distribution Mains	
			Leakage and Overflows from the Utilities Storage Tanks	
			Leakage on Service Connections up to the Customer Meter	

It seems likely that the bulk of the DJB's losses are among the first two categories. During MSc fieldwork in Maharashtra, a Municipal Commissioner explained to me that nearly half of his city's water balance, marked as 'free water' on their records, was being given to slum

[36] Personal communication, Aman Sethi, journalist and author, Defence Colony, Delhi, 02/06/15, fn86

settlements (Birkinshaw, 2016). In Delhi, researchers on urban services for the poor similarly suggest that an ambiguous use of NRW could be hiding commercial losses by the utility to various users, including local industries and multinational water companies[37]. 'Any free connection permitted by the DJB' is an 'Allowable Exclusion' to the Malviya Nagar PPP Operator's targets for collection efficiency (Delhi Jal Board, 2012, p. 2002). However, in his 2003 PhD thesis, Alankar, now at Centre for the Study of Developing Societies, using DJB figures, notes that just 8% of Delhi's water is unbilled and includes water to unauthorised, informal colonies, while 37% of *billed* households are on 'unmetered consumption' – 'average bills', which function as a regressive subsidy (see p90 and 138 below). These figures gives the actual physical losses as only 2%, the rest are commercial losses (Alankar, 2009, pp. 182–183). Other water researchers agree.

> Physical losses cannot be as high as 75% or groundwater would be rising. Commercial [losses] could be though – especially if squeezed by private supply from Sonia Vihar. Fixed payment [must be made], even if water is less than billed, then fines [for DJB are levied] for failure [by the DJB] to supply required amount [to PPPs]
> (Personal communication, Dunu Roy, south Delhi, 21 August 2014, fn4).

Another analyst makes the following observation, placing less blame on the water sector multinationals and more on Delhi's industrial and business sectors:

> Half of the NRW (Non Revenue Water) is theft. Why is this happening? [rhetorical] Tankers are very expensive. Slums are not using NRW. 10lpcd from tankers and 40lpcd is the norm from standposts. 165lpcd for posh houses. The theft is in industries, and the commercial sector, through political will and cronyism. Tankers are also part of the private system – so the leakage may be biased.
> (Expert roundtable on innovation in water and sanitation services, Development Alternatives, November 2014, Chatham House rules, fn38)

The DJB now has increasing block tariffs under which consumers pay incrementally more for higher use of water. However, some consumers may avoid paying higher charges by registering a faulty meter in order to be placed on an 'average bill' instead. The DJB has consistently attempted introduction of volumetric meters and billing by use, however many

[37] Afsar Jafri, Focus on the Global South, meeting August 2013 (Jafri cited for same point in V. Asthana, 2009, p. 159); personal communication, AAP workers, Chirag Dilli, December 2015, fn35

metered consumers have found that their meters do not read accurately. If a meter is not reading accurately the consumer can be placed on an average bill instead. This is the total volume of water supplied to Delhi divided by the number of users. This can be substantially cheaper than metered consumption and removing or ignoring water meters has been a tactic of consumers since before the DJB was formed (Debroy, 1997). According to respondents, meter readers could be induced to find fault with the meters and place users on average billing in response for a small consideration (Personal communication, PPP staff, 9 August 2015, fn110). The practice is widely reported:

> ''DJB meters are dilapidated. As per rules, a water meter has to be verified every two years, a rule hardly followed,'' Harpreet Singh Kandra of Teri said. A Shalimar Bagh resident, requesting anonymity, said in such cases ''ad hoc readings were the practice''.
>
> ''This a popular practice as getting a meter replaced is a cumbersome process. And if you are willing to pay a certain amount, your rent is fixed at the lowest rate.''
>
> And this leaves ample space for corruption, making the DJB a loss making body in the whole process, said DJB chief P K Tripathi' (Times of India, 2002).
>
> It is DJB field staff and authorised plumbers who are mainly responsible for the huge [financial] losses […] in most cases meters were not installed, while a majority of those installed were rendered non-functional by the field staff in order to minimise consumers' bills (S. Joshi, 2005).

Available figures for 2013 suggest that of 1.9m connections, 850,000 had 'properly working meters', 350,000 had no meters, and 70,000 had meters which were 'non-functional or faulty. In the absence of properly functioning meters, the DJB had been charging on 'an ad-hoc basis', resulting in 'incomplete billing revenue' (Hindustan Times, 2013). Meters are a consistent source of dissatisfaction and campaign target for opponents of privatisation. Announcing an amnesty on water arrears in 2015, Delhi Chief Minister, Arvind Kejriwal said: "When we analysed water bills, we found these in a disarray as most water bills were prepared on an average basis without reading meters. It will be impossible to sit to correct these bills." (NDTV, 2016)

In previous research on urban service reforms in Maharashtra I spoke with consultants involved metering reforms who had spent six months working with meter-reading staff on a

daily basis (Birkinshaw, 2013). In this city, meter readers were so overworked that they had informally subcontracted their rounds to a large number of other people. Our interview made it clear that corruption was complex, varied and widespread. In a study using 1,400 interviews with customers and staff of water utilities in Delhi, Chennai, Bengaluru, Tamil Nadu, Kerala, Hyderabad, Ahmedabad, and Jammu and Kashmir bribes to meter readers for falsified readings, were reported to be the most frequent type of corruption (Davis, 2004, p. 55)[38]. 41% of customers said they had made a payment in the last six months. 73% of staff said that these payments happened "about half the time" or "virtually all the time". However, the amount was very low, around ₹20 (reported as $0.45, exchange rate in 2003 was ₹45-US$1). According to a senior water board official in Bengaluru: "The [meter reader] nexus is so deep-rooted that it's they who decide the change of officers, both in the [Bengaluru Water Board] sub-divisions and main office. Most of the water meter readers and meter inspectors have amassed huge wealth, only to dupe the Board" (Menezes, 2016).

> As one supervisor noted: With the meter reading, the men are in the field and we have no control over them. Most of our meters do not work properly. It is accepted for the meter reader to give an estimate when there is no proper meter reading. We cannot go and check all the meters ourselves... [W]e must accept what they tell us... (Davis, 2004, p. 55)

UNRELIABLE SUPPLY AND PERSONALISED INFRASTRUCTURES

The DJB employs several strategies to be able to give water to people in different areas of the city (Biswas, 2015, p. 135). For formal areas connected to the piped network, a major feature of government water supply is rationing water through intermittent supply. As in many Asian cities, water supply is provided to different areas for several hours at a time at different times of the day and night. Areas may get supply for two-four hours twice a day, an hour every morning, an hour every second day or an hour once a week. Crude aggregate data suggests that the timings (and corresponding quantity) of supply is a result of population expansion in more outlying areas. However, this picture for the city as a whole

[38] Similarly, a study in Bangladesh found that one third of urban households had their water bills reduced through an arrangement with their meter reader (Gonzalez de Asis, O'Leary, Ljung, & Butterworth, 2009, p. 12).

(see NCRPB maps above) is overlain by differential quantities of water supplied to neighbourhoods with different planning status.

Discussion of the issue of water timings reveals a facet of water inequality that is masked by aggregate and average figures (Marie-Hélène Zérah, 1998). For those lucky enough to have a water connection the length of time and hour of the day that water is available vary widely, as do other attributes such as pressure and quality. These variations are strongly shaped by several factors, one of the largest being the areas status according to the Delhi Master Plan. 'Non-Plan' areas such as unauthorised colonies and slums are often worse off. However the situation is the outcome of a negotiation of complex factors. Topography and proximity play an important role in access to water, both in the geography of naturally occurring underground aquifers and the distribution of water infrastructure such as treatment plants, underground and elevated service reservoirs (Alankar, 2013; Datta, 2012, p. 135). Material influences include such as distance from key infrastructure (treatment plants, storage reservoirs, booster pumps, zonal inlets etc), elevation and slope of the area, extent of illegal 'tapping' of the network upstream, and age of the pipes. Socio-political influences include efficiency and power of local politicians, political influence of local residents, class and caste status of residents and political affiliation.

My own calculations using publicly available timings data for 192 locations across zones East I, East II, South I, Project WI, Project WVII, Project WIX gives an average supply of two hours and seventeen minutes, although this is skewed upwards by claims of twenty four hour supply in two areas. It also seems worth observing that 86 of the 193 localities (the majority in Mehrauli) receive one hour on alternate days. 75.5% of Delhi's population may have some form of connection to the network, however, availability of water in the pipe varies (Comptroller and Auditor General, 2009). In South I zone, for example, water availability is stated to vary between 24 hours a day (Vasant Vihar) to one hour a day 'in rotation' (no fixed times) 'under normal circumstances' and 'subject to availability' (Mehrauli) (Delhi Jal Board, 2014b).

Intermittent supply also has a negative effect on the physical structure of the pipes, causing them to wear faster. This is due to the impact of water being pumped through then

stopping causing it to 'hit' the corners, junctions and valves. Joints in small (e.g. tertiary level) iron pipes are the area most likely to fail (Kettler & Goulter, 1985). Water pipes have been historically laid next to sewer pipes (and electricity and gas cables in more planned areas). Low pressure intermittent supply causes water quality problems as material from the surrounding soil is able to enter cracks in the pipes, particularly problematic when water pipes are laid next to sewage pipes, or lack of adequate sewering or unlined septic tanks leads to sewage in the soil. Where sewer pipes are also leaking, or there are other liquid pollutants in the soil these are able to enter the pipes at periods of low pressure. As a result government water supply is not clean and not trusted by water users. In addition to ingress to the pipes, surface and ground water sources are substantially contaminated, with pollutants including raw sewage, industrial chemicals and heavy metals[39].

The time that water is provided, as well as the duration varies with location. Unauthorised and less wealthy neighbourhoods get shorter hours at less convenient times. If, like one house I lived in, water arrives *sometime* around four am, somebody must be awake to turn on the pump. If the pump is not turned on the household will not be able to fill their tanks with water to use later. The first people to turn their pumps on may get muddy, gritty or dirty water, however, if people are too slow to turn their pumps on there may not be water left[40]. This can cause fights between family members and flatmates if the person responsible does not wake up[41].

This kind of intermittent supply and variable water timings means that the figures given for percentage of population connected to the water network, as provided by the census for example, can be misleading. Delhi's average water distribution figures, as with many other aspects of the city, display a staggering inequality. When asked about this, the DJB often

[39] Personal communication, local resident, (male, 45), urban village (Hindu), south Delhi, 21/1/15, fn14; Personal communication, local resident, unauthorised colony, South Delhi, 5/3/15, fn27; Personal communication, local party volunteer, urban village, December 2015, fn35; Personal communication, local politician (male, 45), Urban Village Extension (Muslim), South Delhi, September 2014, fn49

[40] Personal communication, residents at Begumpur, January 2016, fn136

[41] Personal communication, resident, (mid twenties, female), 7/08/15, fn109; Personal communication, Dr Manisha Priyam, NEUPA, South Delhi, 2014, fn42; personal observations

link the issue to a scarcity of bulk water for the city[42]. The DJB claims to supply 280-300 lpcd on average, against a recommended Central Public Health and Environmental Engineering Organisation (CPHEEO) standard of 150lpcd or Bureau of Indian Standards norm of 150-200lpcd (Central Public Health and Environmental Engineering Organisation, 1999, p. 9; Bureau of Indian Standards, 2007, sec. 4.1). The Bureau of Indian Standards also offers a supplementary note that the value of 150-200lplcd may be reduced to 135lpcd for 'Lower Income Groups' 'depending upon prevailing conditions'. However, the differences in distribution are larger than these norms.

Within regions of Delhi that get good overall average water supply there is still a dramatic difference between neighbourhoods. A large influence on this is planning status. The Delhi Jal Board officially distinguishes seven categories of settlement to which it provides water in different amounts, qualities and means: Planned colonies, regularised unauthorised colonies, unauthorised colonies, urban villages, rural villages, resettlement colonies, recognised slums, JJ clusters. Based on CPHEEO norms the DJB allows for four levels of water supply to different settlements (see Table below). However, the Centre for Science and Environment argues that 'according to the State of Environment Report for Delhi, 2010, actual water supply is somewhat different. Slums and unauthorised colonies barely get 9lpcd while planned colonies are provided, on an average, 270 lpcd' (Centre for Science and Environment, no date). In other studies, the difference in supply quantity is even higher; Dutta found average daily consumption in the unplanned areas was 67 lpcd but cites other studies in which average consumption ranged from 646 lpcd in wealthy areas to 16lpcd in slum areas (Dutta, 2010, p. 27).

Table 4. Delhi settlement types, approximate population in 2000, and water situation

Delhi settlement types, approximate population in 2000, and water situation (Kavarana et al., no date; Maria, 2008, p. 10; Planning Department, 2001, p. 129)						
TYPE	POP. (MILLION)	% OF TOTAL EST. POP.	DJB LPCD NORM	ACCESS TO WATER CONNECTION (PRE-2016)	TENURE	POVERTY
JJ clusters	2.072	14.8	70	No right to individual connection	Illegal	High
Slum designated areas	2.664	19.1	70	Restricted by technical features	Legal	Mixed
Unauthorized colonies	0.74	5.3	70	No individual right	Semi-legal	Mixed

[42] Expert roundtable on innovation in water and sanitation services, Development Alternatives, November 2014, Chatham House rules, fn38; Personal communication, Superintendent (Planning), DJB offices, Jhandewalan, Delhi, 10/04/15, fn51

JJ resettlement colonies	1.776	12.7	150	Official right not respected	Legal	High
Rural villages	0.74	5.3	150	Not under responsibility of DJB	Legal	Low
Regularized-unauthorized colonies	1.776	12.7	168	Good situation	Legal	Mixed
Urban villages	0.888	6.4	168	Good situation	Legal	Mixed
Planned colonies	3.308	23.7	200	Good situation	Legal	Low
Total	13.964	100				

Delhi has hundreds of unauthorised colonies of which 1639 have applied for regularisation and 895 have been deemed eligible (Sheik & Banda, 2016). Scholars suggest around four million people in the capital live in unauthorised colonies, although data is imprecise (Sheik & Banda, 2014; Zimmer, 2012). As mentioned unauthorised colonies and urban villages are related by more than their exceptional status in Delhi's planning regime. Village fields are sold to real estate dealers who then subdivide them into plots of various sizes and conduct negotiations with the builder-developers, individual families or investors who will take possession of the plots for construction (or investing in land – which conveniently soaks up a lot of cash, which accumulates in black market transactions across the city)[43].

Unauthorised colonies have no automatic right to urban services and must be issued with a No Objection Certificate from the Delhi government before they can be supplied with water. In 2008, guidelines and regulations for authorisation were issued; 'a whole thicket of legislation' (Sheik & Banda, 2016, p. 140)[44]. It was also around this time that electricity distribution was being privatised in Delhi. So a private electricity lobby may well have been interested in access to these consumers. Indeed, innovative billing and collection methods were developed for electricity in unauthorised areas (Das Gupta & Puri, 2005). The regularisation process is ongoing on a case by case basis.

This sizeable proportion of the city population (c.17%) is primarily reliant on discretionary spending and support from politicians for urban services. The possibility of regularisation, again an area for the exercise of political influence, offers not only improved services, but a

[43] Personal communication, water supplier and real estate dealers, Sangam Vihar, 19/0815, fn133; Personal communication, real estate dealers, Sangam Vihar, 06/02/15, fn17; Personal communication, real estate dealers, Sangam Vihar, 16/05/15, fn76; cf (A. Bhardwaj, 2015c)
[44] Personal communication, Aman Sethi, journalist, South Delhi, 2/06/15, fn86

substantial increase in real estate values. A real-estate dealer and relative of a senior local politician described this 'vote bank politics' to me bitterly:

> Government does nothing, unauthorised [colonies are] only a vote bank. We can't complain, they will just say "unauthorised". The MLA, MPs get money in, but can't spend it on unauthorised colonies. This means it is money in their pockets that they can use for re-elections. It costs about one crore[45] to fight an election - liquor, votes. Give 5 lakh[46] to the police, they will look the other way and a car full of liquor will come through.
> (Personal communication, real estate dealer (c.40, male), Sangam Vihar, 06/02/15, Hindi, fn17.

The 'money' he referred to is from discretionary local area funds. MPs and MLAs have Local Area Development Funds of five crore (₹50,000,000 / c. £500,000) and four crore respectively, while local counsellors get less. The idea that they are not allowed to spend these in unauthorised areas is prevalent, however some spending does still take place, and these discretionary funds are often the only source for areas which are excluded from other sources of government funding for urban development.

However, for government as a whole, a major disincentive to provide individual connections to households in non-plan areas, like unauthorised colonies, is that this will be seen as an implicit approval of tenure. For researchers, non-governmental organisations and residents, it seems obvious that provision of services should be separate from tenure status and the cost of provision would be recovered in a few years through health cost savings[47]. An elderly villager put it like this:

> You need papers to get a connection. Village people don't have any papers!
> (Personal communication, elderly resident (c.70, male), urban village (Muslim), South Delhi 10/03/15, Hindi, fn16)

In other words, 'access is prevented by layers of bureaucracy: a letter from Municipal Corporation is needed, a No Objection Certificate from the police… These are things that only the politically connected can get. Even within areas of piped water supply these social

[45] A crore is 10 million
[46] A lakh is one hundred thousand
[47] Expert roundtable on innovation in water and sanitation services, Development Alternatives, November 2014, Chatham House rules, fn38

issues and differentiations are there'[48]. As Hafiz, a young RWA president and businessman, explained:

> Getting water is a 'grey market'. It is a lot of hassle to get a connection. You must have a lot of documents, like two forms of ID, a proof of address. No one in the village has a proof of ownership because it is all Power of Attorney transactions. Once you have got all this stuff and put in an application. The survey guys will come to check that your house actually exists. They will want some money to make sure that the work gets done ok. After this some people will come to check you docs, they will also want some money. It takes about 45 days to get a connection."
> (Personal communication, RWA President, urban village (Muslim), South Delhi, 10/03/15, fn28)

The DJB approach before 2016 was to supply unplanned areas through a mix of tubewells and tankers. At time of research, the DJB is using water from tubewells for some unplanned areas in Malviya Nagar (Khirki, Hauz Rani) and Vasant Kunj. The DJB justifies giving tubewell water because it's not for drinking[49]. DJB data (at Appendices WU and PD, p289 and p291) describes Hauz Rani as having 15,627 residents and 937 consumers. The same data describes Khirki village and extension as having 2834 consumers and 43,567 residents. Clearly many residents in these areas have alternative water sources to the DJB.

> [Talking about urban villages and unauthorised colonies:] Sonia Vihar water only came 5-6 years ago - before this the whole area was on tubewell and tanker water. But people now don't want tubewell water they expect Sonia Vihar water - they don't like it because it's hard. They demand piped water. The previous government promised Sonia Vihar water.
> (Personal communication, PPP Public Relations Officer, M 45, South Delhi, 21/04/15, fn55)

Technically the tubewell networks and piped supply are supposed to be running in parallel but in reality they are connected and groundwater is also in the treated water pipes (Personal communication, PPP senior manager, Delhi, 21 April 2015, fn56, the Detailed Project Report (DPR) also shows this). An elderly resident told me that the large government

[48] Expert roundtable on innovation in water and sanitation services, Development Alternatives, November 2014, Chatham House rules, fn38
[49] Personal communication, Aman Sethi, journalist, South Delhi, 2/06/15, fn86

tubewells in the area were installed fifteen years ago had dried up five years ago[50]. They were replaced by smaller, deeper wells. The tubewells were described as politically convenient *ad hoc* solutions.

> "The Councillor and MLA need a vote bank - so they give piecemeal solutions - every time when people complain they will give a new tubewell for votes but will not fix the system properly. There are about 25 tubewells inside the *lal dora*[51]."
> (Personal communication, local resident, urban village (Hindu), 21/01/15, fn14)

The use of government tubewells to supply water to some areas leads to direct provision of untreated groundwater. Some areas where I lived are supplied by DJB tubewells. This water is supplied untreated and is very hard and clearly distinguishable by a 'milky' taste and 'thicker' appearance. Tubewell water is supposed to be supplied in a parallel network to treated water, if treated water is provided, however, in my research sites, both networks are interconnected. Kishore described the water supply to our village with some anger:

> DJB borewells are there. They give dirty water. Bills are still given by the DJB. The water used to be 20 feet below ground 20 years ago. Now it is 400 feet, salty and hard. The water is very bad. The TDS [total dissolved solids] is high. The limit is 150, but quantity is 1000[52]. The water is so bad that RO [reverse osmosis filter] machines will break. I have stones in both kidneys from the dirty water. My hair is gone [many people believe bad water causes hair to fall out]. We use the tap water in food, for lentils [*daal*], bread [*chapatti*] and for bathing. What can you do? Everyone uses it. All people know that it is bad so only bathe and drink bottled water, 80-90% of people, everyone who can afford it. Very poor people cannot afford bottled water and they have to drink tap water. We still get billed by the DJB for ground water though. They have meters for it. There are 1, 2, 3, 4, 5 tube wells in this area [points in various directions, an arc going south to north east]. I cannot show you for my own safety. These are government tubewells, but they get captured.
> (Personal communication, resident (male, c.45), urban village (Hindu), south Delhi, 21 /01/15, fn14)

[50] Personal communication, RWA president, urban village (Hindu), 21/01/15, fn14
[51] *Lal dora* [red thread] was the line demarcating village common lands on official plans, these are the areas that have become unauthorised extensions – see page 52
[52] This was also mentioned by other respondents, and PPP technical reports confim it. Personal communication, local politician (male, 45), Urban Village Extension (Muslim), South Delhi, September 2014, Hindi, fn49; Personal communication, pradhan, Sangam Vihar, 03/07/15, Hindi, fn91; PPP Project reports confirm this (DRA Consultants Pvt. Ltd. & Shah Technical Consultants Pvt. Ltd., 2011a, p. 192) see Appendix WQ page 288

I was told that main Muslim neighbourhood in Malviya Nagar, Hauz Rani Extension, is entirely supplied by tubewells, while Hauz Rani village is divided into three areas, one with piped supply, one with tubewells and one with no supply[53]. Discrimination and marginalisation mean that Muslim neighbourhoods are very dense. Cheap rents lead to a visible population of international migrants in this part of the city. Total dissolved solids in the water, used as a proxy measure for pollution in India, in Hauz Rani was quoted to me as 1200 mg per litre. DJB data also shows low water quality and gives the reading as around 1,000 for a neighbouring area (Khirki Extension, see Appendix WQ, page 288). Water is considered brackish (and no longer acceptable for human consumption) at levels of over 500mg per litre. According to the DJB's own chemical analysis, only three out of 24 tubewells in the Malviya Nagar area tested were supplying water fit for drinking (DRA Consultants Pvt. Ltd. & Shah Technical Consultants Pvt. Ltd., 2011a, pp. 192–194). In Hauz Rani, estimates are that of the 40,000 residents, 25% use RO filters, 25% drink bottled water and 50% drink the groundwater directly[54]. The groundwater is said to cause jaundice and kidney stones[55]. A popular belief is that it will make drinkers' hair fall out[56]. Residents described it as *zaher*, poison[57].

> Nishan: Water is the biggest problem in this area, it causes diarrhoea, vomiting, [another illness mentioned, but I don't know the word], loose motions, you know... What else? <she asks the receptionist> Viral fever, typhoid - typhoid is fatal if untreated. […] Maybe 2-3 cases a day, or a week. If the case is serious they will refer to a government hospital like AIIMs, Safdarjung or Batra [...]
> (Personal communication, hospital staff, Private Hospital, Sangam Vihar, 16 May 2015 (Hindi), fn75)

[53] Personal communication, local politician (male, 45), Urban Village Extension (Muslim), South Delhi, September 2014, fn49; Personal communication, RWA President (male, 30), urban village (Muslim), South Delhi 10/03/15, fn28

[54] Personal communication, RWA President (male, 30), urban village (Muslim), South Delhi 10/03/15, fn28

[55] Personal communication, local politician (male, 45), Urban Village Extension (Muslim), South Delhi, September 2014, fn49; Personal communication, local resident (male, 45), 21/01/15, fn14

[56] Personal communication, local resident (female, 25), 7/08/15, fn109; Personal communication, local resident (male, 45), urban village (Hindu), south Delhi, 21/01/15, fn14

[57] Personal communication, local resident, (male, 45), urban village (Hindu), south Delhi, 21/01/15, fn14; Personal communication, local resident, unauthorised colony, South Delhi, 5/03/15, fn27; Personal communication, local party volunteer, urban village, December 2015, fn35; Personal communication, local politician (male, 45), Urban Village Extension (Muslim), South Delhi, September 2014, fn49

In order to cope with these various and unreliable types of supply, many forms of deviation from the public system exist: personalised infrastructures such as pumps, tanks and filters; modifications of the piped network; and illegal connections and non-payment. These may be both 'co-production' of service (as with tanks) or 'quiet encroachment' (as with pumps) (Ahlers, Cleaver, Rusca, & Schwartz, 2014; Bayat, 2000).

The most easily available way of coping with unreliable water supply is storage in underground and over-ground tanks. Even for people on very low-incomes water storage is essential. Studies in other cities have found that overhead storage are 'available almost exclusively to upper income households' (Burt & Ray, 2014, p. 111), however this is not the case in Delhi. People store water in overhead plastic tanks, and, for larger households, underground tanks. People with very limited space store water inside their houses or outside in the street (Datta, 2012, p. 141). This imposes a need for space, which becomes an issue for people with less money as tanks and barrels take up household space[58]. Rooftop tanks in shared buildings are padlocked to prevent water stealing[59].

As Delhi's water supply is often at low pressure, households in many parts of South Delhi use supplementary pumps installed on their line to increase the pressure.[60] These booster pumps suck water out of the pipes during supply hours. Without a pump the pressure is too low for water to reach in any quantity and certainly not to upper floors. As different powered pumps give greater suction, spending more on illegal pumps (above 1hp) will allow greater water security and reduce the amount that other nearby users are able to take. Booster pumps (or 'motors') are usually installed in cages outside people's houses, occasionally, bigger motors are in the ground floor parking area. In unplanned areas, the whirring of water motors can be heard throughout the lanes at all times of day and night, not just water supply times. This suggests that many residents use groundwater as a supplement to the DJB piped supply.

[58] Observations, Sanvam Vihar, 16/02/15, fn24; Personal communication, group of residents, slum colony, 28/01/16, Hindi, fn128; Observations, South Delhi JJ Cluster, 23/08/14, fn139
[59] Personal communication, residents, Khirki Extension, field note 95; conversations and observations at Kapasevra village, south west Delhi, fn89
[60] Personal communication, PPP Public Relations Officer (mid 40s, male), Malviya Nagar, 21/04/15, fn55

> Online booster pumps are illegal. Absolutely illegal. [They] can be used [legally] to pump water from a ground tank to an upper tank but that is it. You see them outside of houses in cages. In some houses you will see a whole row lined up like a booster pumping station!" <laughs> […] Everyone is using them. Even our customer care centre has a pump! [This was repeated because I didn't write it down the first time.] Even the DJB facilities have pumps!
> (Personal communication, PPP Public Relations Officer (male 45), South Delhi, 21/04/15, fn55)

Motors fixed on government connections cannot be automated[61]. As previously mentioned, intermittent supply gives water at set times, however, timings of government water are not exact[62]. More affluent areas get better timings and longer hours, and variation in timings can be considered another aspect of supply quality. Running a motor without water in the pipes is bad for the motor and will pull air through the meter, if there is one, leading to high bills. This means that someone must be able to manually turn on the motor at the water timings to receive water. Waiting for water to come in the pipes to turn the motor on can lead to disturbed sleep, delays in leaving the house, and can be a source of tension in the household. This is one reason why groundwater can be preferred - it can be accessed at any convenient time - for no charge.

Water pumps or 'motors', legal and illegal

> People do not generally have private bores anymore [his friend had earlier said 80% of people use private bores). There are private bores from before they got banned but these do not work anymore because the water table has fallen. It costs

[61] Personal communication, water pump dealer (mid 50s, male), Malviya Nagar, 21/08/15, fn135
[62] For this phenomenon in 19th century London see (Taylor & Trentmann, 2011)

> ₹500,000 (£5,000) to get a private bore [this is the same as school admission or starting a business]. This goes to the SDM [Sub Divisional Magistrate]. Under him is the new Naib Tehsildar. I have filed [a complaint] against him [the Naib Tehsildar]. Boring is not done by companies or publicly recognisable people. There are one or two offices that I know. It is done by people that you have a 'setting' with. The police station [*thana*], the SDM and the Tehsildar can arrange for you to meet people also.
> (Personal communication, local resident, property dealer and Right to Information activist, urban village (Hindu / Dalit), South Delhi, 21/01/15 (in Hindi), fn14)

As increasing numbers of people use motors, for both DJB water and ground water, those without become less likely to receive any water. As Ram Singh, who owns a small chai shop in an unauthorised colony in Malviya Nagar, explained the water situation in his neighbourhood to me. People had laid pipes themselves (illegally) which were connected to the DJB piped network. Water comes between 4.30 and 6am in the morning and at the same times in the evening.

> When there are too many people on a connection the people closest to the main line and with the bigger pumps get the water and the people at the 'tail end' cannot get any. For the first half-hour the water that comes is dirty, we have to pump that and throw it away, then clean water comes. […] Sometimes sewer water gets in the pipes when the pipes get broken. […] The problem is that as more and more people live there and houses get built higher the people become too much. Everyone has motors that they use. So after time a connection becomes bad and the water gets over. Then we must abandon the old pipe and get a new connection. It costs 4-5,000 rupees for a connection.
> (Personal communication, chai shop owner and three customers, urban village, 28 January 2016, conversation in Hindi, fn129)

Research in Delhi 15 years earlier also gives the figure of ₹5,000 to ₹7,000 for illegal connections from the DJB (Tovey, 2002). When I asked Ram Singh if they needed DJB permission to make a new connection, he replied vehemently: "this government wants you to take a permission just to eat food!" He would not say who did the work of providing connections. In a different, but nearby, urban village Kishore, a real estate broker and AAP volunteer, told me that a water connection required a much larger illicit payment, ₹15,000 (£150 at time of research)[63].

[63] Personal communication, residents, urban village (Hindu/dalit), south Delhi, 21/01/15, fn14

Household investment in personalised infrastructures in India has been observed in previous research (Marie-Hélène Zérah, 2000a; Briscoe & Malik, 2006, p. 57; Burt & Ray, 2014; Button, 2016). In a report for the World Bank, Briscoe and Malik, note the existence of these extensive private infrastructures (pumps, tanks, filters) at the user end of the network, and the challenges they raise for reform projects. We return to this issue in *Chapter Seven* in the context of Delhi's PPP water reform projects.

> A particular challenge in India is that house-holds have made such large personal investments in 'coping with poor public services'. This has not worked badly—a middle-class family in any of the major cities actually gets water 24 hours a day, even though the water from the utility comes for just an hour or two. Middle-class families have done this by making large investments to cope. But the existence of these 'sunk costs' poses a particular challenge, because these users would actually benefit little in the short run from more reliable supplies. This means that, again in the short run, they would oppose higher user charges, even if service quality improved (as is evident in Delhi in 2005). […] *An additional factor that needs to be factored into the design of tariff reform is the fact that the status quo is quite satisfactory to many in the public agencies who profit from the discretion which they exercise.* This is […] a central, perhaps the central challenge for a progressive government. (Briscoe & Malik, 2006, p. 57 my italics)

INTERCESSION

As the quote above suggests, the dependence of 'unauthorised' areas of the city on ad-hoc service provision, often in response to political lobbying leads to a conflict of interest in which area representatives may derived political capital from delivering service improvements but would render themselves redundant if these improvements were permanent. This phenomenon is commonly known in India as 'vote bank politics'.

Suptendu Biswas shows how even within the formal areas of South Delhi discretionary political spending distorts water distribution norms and practice (Biswas, 2015). Augustin Maria told me that 'there is no one rule' for how water is accessed[64]. Patrick Heller, describing the results of a large multi-site research project, similarly, stated that the team had found 'two hundred different negotiated settlements'[65]. Aman Sethi, the writer,

[64] Personal communication, Augustin Maria, Janpath, Delhi, September 2013
[65] Urban Transformations in India conference, India International Centre, Delhi, 26/08/15

described people's water access strategies as 'a mishmash', a 'combination of all different things'[66]. In conversation with the DJB too, the ambiguity was apparent. There were smiles and hesitation when I asked about unplanned areas in an interview at Head Office. "The issue is complex, gets complicated. Water is a right. Tankers are used". Sunil says "people must get water", but Gaurav stops him and says "I would not go that far". It seems to be a grey area but they do not want to discuss details (Personal communication, Chief Engineer Planning and assistant, DJB offices, Jhandewalan, Delhi, 10 April 2015, fn51).

I observed many intercessions made by MLAs, party workers, agency staff and *pradhans*. My fieldnotes record many requests for interventions, described by residents themselves, or witnessed during time I spent at agency worksites and political offices. The notes below, describe several requests for intercessions at the DJB head offices over the course of a few hours one afternoon. My notes from other offices record many other such incidents.

> Some people came in from [an area in South Delhi] with the media guy, Pradeep. It seemed that they live in an urban village and that they have not been given water connections despite being 100m from the mainline, even as water in the mainline is being given to new colonies that have come up more recently[67]. Pradeep brought these people to talk to the Minister on a personal level, even though he was here for a film. The Minister listened to them, then he was like, ok, we should be able to sort that out. Send me a letter saying please act on this urgently, etc […]
>
> A very tall Muslim Afghani looking young guy came in with his father. He seemed like a politician and he was complaining and saying that he did not want tankers he wanted proper piped supply. […]
>
> Some other people came in from Chhattarpur with a female politician who everyone knew. She had come because they were not getting piped supply and there was a problem with the tanker supply.
> (Observations, MLA's Office, DJB HQ, Jhandewalan, 06/05/15, fn68)

Water provision varies across the city, however for those living in areas not in accordance with the city masterplan, water provision is subject to a much greater degree of idiosyncrasy and discretion. In areas without piped supply already, interventions generally are quite ad

[66] Personal communication, Aman Sethi, journalist, South Delhi, 02/06/15, fn86. Borthakur describes this in Bangalore (Borthakur, 2015, p. 13).
[67] There has been extensive media coverage of this case

hoc and personalised. If the resident is unable to obtain official supply landlords may arrange for water provision[68]. If the residents are able to prove that government is failing to supply, groundwater extraction is legal, however evidencing the proof is something of a legal nicety[69]. For tubewells, as we will see in Chapter 5, the MLA has the power to approve or ignore proposals for new tubewells, as well as influence the speed and site of installation[70].

This personalised intervention can lead to positive outcomes such as the centrally located slums which get piped water for free (discussed further in Chapter 6, PPP). Rani Camp is a recognised slum, settled around 1971 by migrants of various states and religions. It was cited by residents in a west Delhi slum relocation site as an example of good development following political intervention.

> Have you ever been to [Rani Camp]? Behind Malviya Nagar? […] the minister there placed everybody in a line [plotted development] and then left lanes and roads in between. He got water installed. Then the camp was passed [regularized], and they got freedom to stay there (Datta, 2012, p. 173).

At Rani Camp, people there told me they do not have a problem with water, which comes through self-laid pipes. The MLA arranges it for them, both the current and previous MLAs names are mentioned (AAP and Congress). They drink the water straight from the pipes; no one uses filters or buys bottled water. Sometimes dirty water comes out of the pipes, probably because they are broken under the ground. People use motors to pump the water. They do not get any bills for water. If they have a problem with a pipe line they call a local plumber to fix it. Tankers do not come - they do not need them. They ask the MLA if they need something. All parties are there. [We could see three party offices from where we were standing...] Different parties can do work, if one does not they can ask another. If one person complains no-one listens but if ten, hundred people complain they have to

[68] Personal communication, Dunu Roy, south Delhi, 21/08/14, fn4
[69] Personal communication, Chief Engineer Planning (mid 50's, male), DJB HQ, Jhandewalan, Delhi, 10/04/15, fn51 – cf (Ghertner, 2017) where the argument partly hinges on a misinterpretation of the legal status of groundwater.
[70] Personal communication, BJP leaders (mid 20s, mid 30s, male), Sangam Vihar 27/11/14, fn125

listen. So when they have a complaint they would make a phone call or send a letter with everyone's signatures on it[71].

> Electricity was free before but now we pay - since 2006-2007[72]. Now we get bills of 10k, 20k, 5k. We do not know how the bills are made. Everyone has electricity meters. *If the bills are too high we phone and complain and the bills can be lowered.*
> (Personal communication, residents, slum colony, 28/01/16 (my translation and emphasis), fn128)

As more than one respondent told me, and I observed myself at water supply and MLA offices[73], a large number of petitioners are a persuasive element of a request: 'When we have a problem we go to the office with 20 men to get the work done'[74]. However, not everyone can successfully access the state in this way. Some confidence and status is a prerequisite, if a personal relationship does not exist.

> The areas that get water every other day rely on tankers. To supplement their regular tankers they call Asad [the MLA's staff member seconded to the tanker station]. Some people came to the office in person to request a tanker. Asad seemed to know some of them quite well - e.g. one older man, who I had initially thought was a colleague because of their easy rapport. *The older woman who came on the other hand was waiting for some time while everyone ignored her.*
> (Observations, Chhattarpur Booster Pumping / Tanker Filling Station, 14/05/15, fn72)

> Ritesh says that there a road is blocked and for this reason some people's tankers are not arriving. He says the same thing to the smart looking man who comes in later. The man says 'we have asked for a tanker but it hasn't come and they just say "we'll send, we'll send"'. Ritesh asks the man to sit outside. He is still sitting outside when I leave about half an hour later. *Why does this guy have to wait for half an hour but the women were sorted out straight away?* (Observations, MLA office, Sangam Vihar, 18/06/15, fn88)

In addition to MLAs and other official politicians, a wide range of people can attempt to 'get work done'. Resident's Welfare Associations (RWA) are organisations partly formed for this

[71] Personal communication, residents, slum colony, 28/01/16, Hindi, fn128
[72] Delhi's electricity distribution was privatised in 2005. In 2003 the Delhi government decided to connect all squatter settlements to electricity (Datta, 2012, p. 99)
[73] Observations of protest, Malviya Nagar Water Services, 19/09/14, fn6; Observations of complaints, MLA office, Sangam Vihar, 18/05/15, fn82
[74] Personal communication, *pradhan*, Sangam Vihar, 03/7/15, Hindi, fn91

purpose – either to maintain the upkeep of their area, or in the case of unauthorised colonies or urban villages to apply for regularisation or petition for better services. The extension of the RWA system was described to me as an attempt by the Congress party to tap into the BJP's constituents.

> "There are two types of RWAs; registered and unregistered. It can be hard to know which is which. Anyone can get people together in a lane and say I'm the boss and print a letterhead and be an RWA. RWAs have to be registered with the [Delhi Municipal Corporation]. Bagidari came afterwards. The Congress felt that the BJP was getting too much influence through RWAs with the DMC so they started the Bagidari to be able to compete with them. Each MLA has four wards under them. The wards each have a councillor. In each ward there is a 'convenor of RWAs' appointed by the [Municipal Counsellor]. I don't know how efficient they are. Because the councillor appoints them so they may not know all the RWAs and some of the RWAs may say "I don't know this convenor I will go to the MLA separately". This Convenor has quite a lot of influence. This system is not written anywhere. It is unwritten rule. I had to sit with the Convenor of RWAs to get him to explain it to me. It is all over Delhi."
> (Personal communication, Public Relations Officer, PPP Offices, South Delhi, 21/04/15, fn55)

Some RWAs from urban villages and unauthorised colonies appear quite different to the 'bourgeois environmentalists' discussed by other researchers (Baviskar, 2003; Ghertner, 2012). The development of Bagidari as an electoral strategy to weaken Congress support is also not mentioned in the literature. Hafiz is the stocky, muscular and enterprising president of an RWA for a Muslim urban village. In his late twenties, he rides a loud motorbike and wears a leather jacket. He has nine brothers and his father had six brothers. His father was powerful in the village. Hafiz appears to have inherited his position of authority and maintains owns many properties in the village, in addition to a new venture in education for standardised tests. He has a law degree and several tough-looking young men at his beck and call. I was taken to visit Hafiz at his office by some young men who seemed to work for him. People in the neighbourhood were surprised that I was asking for him. 'He owns all the property around here', one told me. His office was new, clean and shiny and situated in a nearby planned area. Hafiz explained how the RWA started:

> 'See this city is built on the village lands, it belongs to the village people. Every area is like this, he says. There will be two small groups of people that are benefitting.

> There are two groups because there are two parties." (Hafiz draws a picture to illustrate this, it is a big square with two small circles at opposite ends). "I have started working for the people not as part of this system [of the two groups]", he says. (I speculate to myself that it is also good for his property business.) In [this ward], [the formal area] is the small unit which the politicians are working for, and [the villages and unauthorised colonies] are left to get on with it and given small things now and then. The politicians like to deal with things on individual basis. They like to do individual's work, like school admissions and pensions. It's easier and much cheaper. It extends patronage which reduces the chances of people complaining against them. The head offices [of DJB and other government agencies] are good. The MLA and counsellors are zero'.
> (Personal communication, RWA President, urban village, South Delhi, 10/03/15, fn28)

At a lower level of 'formality' the *pradhan* (local leaders) system also operates (Datta, 2012, pp. 88–91). While RWAs may be 'registered or unregistered' the *pradhan* system is not supposed to exist in Delhi, and appears to be a continuation of earlier practices. The Hindi word literally translates as 'head', 'prime' or 'chief'. Several people, including Hafiz, told me that it was a rural thing and not current in Delhi[75]. However, it clearly continues in some areas. In addition to urban villages, pradhans are also prevalent in *bastis* / *jhuggi jhompri* clusters and some unauthorised colonies. For example, Jha et al, working for the World Bank, discuss the politics of water supply in informal ('slum') settlements, and the role of *pradhans* in facilitating or obstructing access (Jha et al., 2007). In some areas there seems to be an overlap between people's who would have been *pradhans*, RWA presidents and municipal counsellors[76].

> In villages you still have a *panchayat* (council of five), *pradhan* system that was there before. This is our Indian system. […] The MLA will know [who the pradhans are], you will go to meet the MLA and the pradhans will be there. The MLA will call you and the pradhans will tell their problems. The MLAs do most of their work for the urban villages because they [the villages] are vote banks. The villages mostly communicate through MLAs and pradhans.
> (Personal communication, Public Relations Officer (PRO), PPP Offices, South Delhi, 21/04/15, fn55)

[75] Personal communication, pradhan and ex-municipal counsellor, Kapasevra, Delhi, 2015, fn33
[76] Personal communication, *pradhan* and ex-municipal counsellor, Kapasevra, Delhi, 2015, fn33; Focus group with local residents, Sangam Vihar, 16/02/15, fn24; Discussion with *kholenwala*, residents and *pradhan* (female), Sangam Vihar, 11/11/14, fn11.

I met many *pradhans* in unauthorised colonies and urban villages, often connected with water business. They are often the wealthiest people in the area (Datta, 2012, p. 89). In Sangam Vihar, I met Viraj, Ram Kumar (p.136), Shiv (p.157), and Meena (a female *pradhan*[77], page 159), while in Malviya Nagar, Hafiz (page 134 above), and Mr Chaudhri. When I was introduced to Viraj, I had already met Shiv, who I remembered as a 'water dealer'. Viraj was sitting on a plastic chair in the lane in front of his office (cf Berenschot, 2010b). A woman was squatting next to him asking for his help with a pension form. My friend Aasha introduced me to him. (I find out later he is also known as Viraj '*panni walla*' [water guy].) […] He didn't really want to talk but said he helps people with getting their Public Distribution System[78] cards and other documents. He said that water and roads are big problems in the area and that lots of people use water tankers. He had been doing the job of *pradhan* for around six years. His house is opposite his office. It is easily the nicest house in the street, four stories, newly painted with balconies and lots of potted plants[79].

Bhalli, a local AAP volunteer, introduced me another p*radhan*, Ram Kumar. Ram was wearing the white *kurta pajamas* associated with respectable men and politicians with a red *tilak* on his head. After chatting at his construction materials business, he caught up with us in the street and suggested I take some rest, gesturing towards some big but fairly ordinary looking gates. Inside was a palatial hall done in marble with saffron cream walls and turquoise ceiling. There were gold lion's heads on the sides of the double staircase leading down from a more private room at the top. There was a black and white picture of his father, also a *pradhan*, garlanded with marigolds in front of the doors to the upper room. A boy is sleeping on a charpoy near the front of the hall. A round table is in the centre of the hall with three chairs around it. I am impressed, awed. The hall would be impressive anywhere but it was so different to anything else I had seen in Sangam Vihar. You could fit two or three cars in the room. It was cool and quiet. We sit and drink tea with Ram and I ask him and Bhalli questions about the history of the area, *pradhanship* and, obviously, water.

[77] While in Datta's fieldsite, the 'exclusion and invisibility of women' among the pradhan model of leadership was striking, in other sites female *pradhans* are present, although undeniably less common (Datta, 2012, p. 90; cf Srivastava, 2015).
[78] India's Public Distribution System provides subsidised food grains for Below Poverty Line households (see Masiero, 2015; Sekhri & Nagavarapu, 2014).
[79] Observations, Sangam Vihar, 10/11/14, fn12

While many *pradhans* seemed to have an authoritarian rule over their area, in some cases elections are held for the role[80] (Datta, 2012, p. 100). In others it has been abolished. Rani Camp residents (mentioned above) were proud of the fact that they had removed the *pradhan* who was extracting money from them, telling me: 'We do not have any kind of *pradhan* - before there was but he was collecting ₹5,000 for festivals and keeping ₹1,000! Now all the boys are together'. I asked them how they stopped it. They say 'We showed him the name of God!' and start laughing[81]. Similarly, Datta describes the decline of older, non-performing pradhans in her Delhi field site (Datta, 2012, pp. 90–91).

For effective representation, whether MLA, RWA, NGO or *pradhan*, skills must be learnt and relationships developed (the contrasting ability to get work done of Sangam Vihar's two MLAs is discussed on page 153). Hafiz, the RWA president introduced above, had a lot of papers relating to his area. 'I will show you all the documents,' he says. He has a plastic folder about the thickness of my fist, full of letters to the MCD, DJB, Delhi Development Authority (DDA), MLAs, municipal counsellors, he also has an envelope full of receipts that register the delivery. He flips through the file quickly. There is a letter regarding the park near [the Hospital] which says it has been acquired by the DDA. Another is concerning sewage. He has all the issues tracked on a spreadsheet and uses email to communicate with the departments. "Now I just shoot of 10 emails at once", he says, "to all the departments at several levels". "They won't do work without some pressure from their bosses"[82]. The ability to intercede like this, once acquired, is valuable political capital. Hafiz, described his campaign for better services in his area as provoking a response from the local counsellor:

> I started this work about three years ago. Most people are not educated, they do not know what their rights are. But I have a law degree. I have a real estate business and now I am into education […] I started and discovered that I had this power of writing letters. When I first started [to seek better public services] the counsellor came. He threatened when I started, he was afraid that he would lose votes. There was tension. I said let me do my work and you do your work. There is not [a] problem, it could even be good for you. But he didn't like it, he was afraid

[80] Observations, South Delhi JJ Cluster, 23/08/14, fn139
[81] Personal communication, residents, slum colony, 28/01/16 (Hindi), fn128
[82] Personal communication RWA President, urban village (Muslim), South Delhi, 10/03/15, fn28

> that it would eat into his votes. Things are better now. But still, the local officials come under some powerful people.
> (Personal communication, RWA President, urban village (Muslim), South Delhi, 10/03/15, fn28)

As further illustration, an AAP party worker from a neighbouring area described how politicians at different levels of the government will 'steal' work from each other in order to claim the credit (more discussion of competitive credit in Chapter Seven PPP ' Sign Wars').

> MCs [municipal counsellors] are loyal to [Congress] so they deny projects. Let me give you a 'live example'. One man wanted street lights. The MLA put the request in but department told him 'we have no lights - they have run out, and anyway you must release funds before we can do anything'. Then the MLA got a phone call from the man saying 'a light has been put in by the [counsellor] but I never spoke to the [counsellor]'. In this way the departments alert them [the counsellors] to work that needs doing and the [counsellors] 'steal' it to get the credit. Votes are very important. Of course they will regard their people and their caste. DJB and other agencies used to working with corruption and reputation or patronage. If try to work outside of this nothing gets done.
> (Personal communication, party worker, South Delhi, 21/10/14, fn9)

In government at city level, the AAP government has continued political concessions to core constituencies, albeit in a progressive manner, through lifeline free water (for low income consumers), waiving of arrears (for the lower middle class), and connection of unserved areas irrespective of land-tenure.

CONCLUSIONS

This chapter builds an argument in response to the question of how Delhi's public water supply is governed, and why it appears to be so uneven, unreliable and unequal. I suggest that a range of informalities, understood as practices outside official guidelines, both physical and administrative, are widely present in Delhi's public water supply at a number of geographic and temporal scales.

The creation of Delhi's water board in 1998 followed significant input from the World Bank advocating water supply reform and liberalisation. The allegations of informal influence from PriceWaterHouseCoopers and the World Bank in the privatisation process were a key

criticism by anti-privatisation campaigners (Independent People's Tribunal on World Bank in India, 2007; Kejriwal & Bhaduri, 2005). It is notable that while the DJB was intended to be a political autonomous commercial model, it appears to have remained susceptible to political interference, a matter the Chief Minister herself noted. Influence over DJB processes is noticeable at both city scale, in low tariffs, and household scale, in dubious meter readings and 'average bills'. Other studies of parastatal utilities and regulatory independence in India have noted similar situations. Dubash describes the political influence over Bangalore's electricity regulation agency, while Wagle et al and Warghade discusses Maharashtra's Bulk Water Regulatory Authority as an instance of incomplete institutional transfer that was subject to political capture (Dubash, 2013; Wagle, Warghade, & Sathe, 2012; Warghade, 2016).

Water tariffs in Delhi were detached from political oversight and raised before privatisation as the World Bank recommends. High water charges and inadequate supply were key campaign issues. The Delhi Election Commissioner suggests that the raising of tariffs may have lost the Congress party control of the city. This would be a case of the government being changed rather than the more common situation of the privatisation contract being renegotiated.

Delhi's water distribution and revenue zoning arrangements are highly complex and unsystematic. The hydraulic, administrative and political boundaries overlap in such a varied manner that water distribution, revenue and political accountability are impossible to track. Even these official infrastructures are hard to understand for state agencies (cf Scott, 1998). The unevenness of water supply across different areas of Delhi is compounded by an inability to correlate water and revenue following an increased number of revenue zones in 2003. Curiously, administrative reforms have led to the inability of the water department to track their own water.

According to the DJB themselves, as well as independent researchers, a large amount of water, perhaps 40 or 50 percent is lost and private groundwater supplies make up the shortfall. These figures are disputed and maybe due to revenue losses rather than leaking water. However, as the water distribution is not accurately measureable, it is impossible to

say how much water is lost to leaks or non-payment. This makes it hard to measure DJB (or other operator's) efficiency – which in turn makes private management complicated and unappealing to bidders. As an example of state-instituted opacity the zone redefinition appears to support the idea of informality as a state-led technique of deregulation (Roy, 2009b).

Water supply per head is highly uneven. Official norms allow deviation according to planning status, but academic research shows that even with planned areas, supply quantities differ. Across settlement types the high level of variation in supply quantity, timing, quality and mode is sufficiently large as to appear idiosyncratic. Consequently, a simple metric of connected or not, does little to explain water supply patterns among neighbourhoods. This is unlike a homogenous network model where connected or unconnected, formal or informal, are the main parameters (Bakker, 2003; Kooy & Bakker, 2015). This suggests that beyond a formal-informal binary, more specific and situated concepts are necessary (Gandhi, 2012; Guha-Khasnobis et al., 2006).

For inhabitants of unauthorised settlements, unofficial 'informal' means are extensively used to obtain government water, or in the absence of adequate official supply. Across all settlement types, inhabitants have invested in private infrastructures some of which mesh into the public network (motors, tanks) while some are independent of it (tubewells). Private supplementary infrastructures such as pumps, storage tanks, and filters are very widely used. Further types of physical change, are more invasive modifications such as meter bypasses, illegal connections, or unauthorised modifications to the piped network. Practically, these effective strategies for coping with low quality, intermittent supply generate user resistance to reforms (Briscoe & Malik, 2006, p. 57; Marie-Hélène Zérah, 1998). Theoretically, these modifications illustrate the 'co-production' of water access, and the blurry boundary between private and public infrastructure, or formal or informal systems (Ahlers et al., 2014; Button, 2016; A. Joshi & Moore, 2004).

These private infrastructures on the public network lead to a zero sum situation where those with more money install bigger tanks and motors or even reroute the piped network to the detriment of nearby users. In some areas, unauthorised connections have a limited

life-span after which new connections must be taken on further 'upstream' on the distribution pipe. A similar situation is played out with respect to groundwater use, at larger physical and temporal scales, depending on the quality of the aquifer and time of year. Deeper wells and bigger motors mean more water for those who can afford them, and less for others. As the water level declines tubewells require more frequent re-boring or reach the limit of extraction.

In 'informal areas' like unauthorised colonies, political influence may be the only route to obtain services. Residents and their representatives (MLAs, RWAs, *pradhans*) use intercession with the authorities instrumentally in order to acquire improvements to urban services both within and outside of the formal frameworks for supply. This has been widely discussed in studies of Indian statehood (e.g. Chatterjee, 2008). The ability to intercede is unevenly distributed and although some elements can be learnt, appears to vary according to area and individual background. The power to deliver improvements to constituencies is highly prized, to extent that representatives will compete with each other to claim credit.

Lobbying for improvements, in response to unreliable supply, creates space for political (and commercial) entrepreneurship (N. Anand, 2011; Björkman, 2015; Contractor, 2012). People may become dependent on mediation to the point where political intercession is the normal way to interact with state agencies (cf Berenschot, 2013, p. 80). Researcher's however, caution that this should not be seen as an *exchange* of water for votes, but rather that provision of services is a demonstrative performance of political power offering the promise of effective office (Björkman, 2015, p. 204 pp.; Vaishnav, 2017, p. 117 pp.). This intercession from public representatives in order to expedite works further increases network unevenness and opacity.

These intercessions and private infrastructures are central challenges for private sector water management initiatives in Delhi which we return to in Chapter Six. In the following chapter I examine informal water supply in greater detail through discussion of non-network water and groundwater use in unauthorised colonies.

CHAPTER 5.

'OFF-GRID' SUPPLY: WATER UNDERGROUND

This chapter responds to the questions *'How do people access water outside of the piped network?'* and *'What role does groundwater play?'* The chapter describes water supply in Sangam Vihar, a large low-income area, urbanised without planning permission and said to be Delhi's largest cluster of unauthorised colonies. Like many of the city's unauthorised neighbourhoods, the area had no connection to the government network until the Aam Aadmi Party (AAP) government began introducing one in 2015. At time of research it was dependent on tankers and tubewells, making it an excellent 'limit case' to understand alternatives to municipal piped water supply. Sangam Vihar is a corner of the city which often features in media and policy reports covering the 'water mafia', an assumed shadowy nexus of politicians, officials, water dealers and gangsters (Indian Express, 2014; Sethi, 2015). Just as 'privatisation' (see following Chapter) is vulnerable to exaggerated characterisations, the 'water mafia' is a well-established trope in representations of Delhi's water.

Sangam Vihar's water network in the wide sense is highly fragmented and exists as much outside the purview of state agencies as within it. There are a range of modes of supply used as alternatives (or supplements in other areas) to piped network water. Household water is supplied from a spectrum of public-privatised-private tubewell networks, public and private tankers, and household tubewells. For those who can afford it, packaged drinking water is also available from private suppliers. These modes of 'off-grid' water supply vary considerably from one another, having different topologies and temporalities and each lead to particular governance dynamics. The modes I discuss in this chapter (tubewells, tankers and bottled water) are more decentralised than network supply and more personalised, allowing greater discretion from key actors. Consequently, compared to network supply, these modes are also more susceptible to diversion and capture, and present more opportunities for patronage, bias and rent-seeking. Tankers, tubewells and (local/illegal) bottled water factories are largely dependent on informal or unregulated groundwater use

and are prevalent in unauthorised areas. In my study site, it appears that the historically dominant land-owning castes' control over informal land and real estate has led to influence in politics and water supply. Tankers, tubewell and water factories, as decentralised and either mobile or inconspicuous operations, are socially and politically embedded and harder to regulate and reform than networked water supply. The informal capture of tankers and tubewells is not a consequence of informality as state-led deregulation, but of state inability to regulate, and political unwillingness, at least until recently, to provide alternatives. This informality is co-constituted by the actions of many actors, with uneven benefits. Informality functions differently across water supply modes, and differently again to informality in other areas of informality such as land and labour.

This chapter is structured as follows. The first section introduces the neighbourhood of Sangam Vihar and its politics. The second section describes the fixed water infrastructure of tubewell networks. The third section describes the mobile water infrastructure of tankers, while the fourth discusses water 'cans' and illegal bottling factories. The chapter closes with a summary argument from the empirical data.

Street scenes, Sangam Vihar. Water on the right is overflow from clogged drains after rainfall

UNRULY WATER POLITICS

> There has been a water mafia in Sangam Vihar for 20 years. In the 49 days [of the first AAP government] we forcefully removed them - we try to get people to engage with the water distribution - we made certain groups of people into committees to manage borewells. We enlisted people to work. They got control of all that was under the water mafia before. These were 15-21 people, from the general public,

> we engaged them by asking people to contact us if they were interested. There are two types of water mafia; tankers and tubewells are captured by people. They capture the tubewells and have private networks. People depend on the tubewells for water - people must give however much money they ask [*jitne paise mangne logon ko dene padega*]. It's a bit political but it won't be supported.
> (Personal communication, Member of Legislative [State] Assembly (MLA), Delhi Jal Board Head Office, 24/08/2015 – English and Hindi, fn117)

On January 8th 2014, 11 days into the Aam Aadmi Party's first government in Delhi, a 'special taskforce' from the Delhi Jal Board (DJB) began 'a massive combing operation' in Sangam Vihar and Deoli. The unit, combining DJB, District Commissioner staff and 'a large police force… deployed to manage the situation', was briefed to 'takeover illegal borewells involved in the extraction of ground water for their commercial interests' (Indian Express, 2014). Sangam Vihar has become notorious for limited water availability and the AAP government launched its operation against the water mafia in a symbolic location. From an estimated total of 165 government tubewells and 200 private tubewells[83], around 35 tubewells were transferred into new management[84] with private security.

Sangam Vihar is a large cluster of unauthorised colonies at the southern/south-eastern periphery of Delhi's state boundary. The area is a vibrant, lively locality with many small businesses, proliferating range of housing types, often clean and nicely painted, and a feeling that rules are relaxed, as well as a certain reputation for crime, even 'gangwar' in popular media[85] (Indian Express, 2013, 2015c, Manral, 2015a, 2015b; News 24, 2015; Times of India, 2016b). Many people in Sangam Vihar have obvious scars, particularly those involved in politics, and the area has a 'street' feel to it. During research, a number of people told me "be careful you are in Sangam Vihar now"; however the atmosphere of the area during daytime is quite pleasant in comparison with more central and higher density low-income urban neighbourhoods. Fear of criminality in Sangam Vihar, while related to its low level of state presence, also revives the British registration of local Gujjar people as a 'criminal tribe', 'addicted to cattle-lifting' (Machonachie, 1884, p. 85)[86].

[83] Personal communication, senior local BJP representatives, Sangam Vihar, 27/11/14, fieldnote 125 (fnX hereafter); cf figures in (Sheik, Banda, et al., 2015)
[84] Personal communication, party workers, Ratiya Marg, Sangam Vihar, 18/05/15, fn81; Personal communication, tanker owner and real estate dealers, Bandh Road, Sangam Vihar, 19/08/15, fn133;
[85] https://www.youtube.com/results?search_query=sangam+vihar
[86] Historical work on water in Delhi is outside the scope of the thesis but forthcoming from the author

The land on which Sangam Vihar is built previously belonged to Gujjar landlords from village of Tughlakabad and Jaat villagers from Deoli[87]. The villages of Deoli and Tughlakabad's 'Goojargaon' can be seen on 19th Century maps of the area (Burgess, 1866). The land was sold off and developed in the early 1980s.

> [The villager who owned the land] divided up the fields and people bought them in a 'chain system', then sold them on. So one person might buy and big plot (subdivided from a field) and then divide further and sell on, and so on. At that time the houses were built of mud and painted, there were no roads, electricity and water was from hand pumps. The government would come and break the houses.
> Personal communication, resident, Sangam Vihar (Deoli side), 17 June 2015 (Hindi), fieldnote / fn87)

Sangam Vihar houses around a million people, the majority on low incomes, and very many families from outside Delhi[88]. The area's exemplary status as a very large area bereft of adequate public services, means that it is unusually closely fought in state elections and seen as something of a barometer of the city mood[89]. Because many people in Sangam Vihar are migrants from other states, they face difficulties in getting voting identity cards. Despite the small percentage of Sangam Vihar residents that are registered voters (13.7%) voter turnout in the area is very high; around 60% in 2012[90]. In 2014, the AAP won a narrow victory in both the Sangam Vihar and Deoli constituencies, which had seen rule by both Bharatiya Janata Party (BJP) and Congress (INC) politicians during previous terms, but little change on the ground. The new government's attempts to transform services at a city level, and locally, within the colony, offer further insights into the functioning of water governance in the area.

[87] Personal communication, party worker, Sangam Vihar, 18/05/15, fn83; Personal communication, local resident, Sangam Vihar (Deoli side), 17/06/15 (Hindi), fn87; Personal communication, water supplier and real estate dealers, Sangam Vihar, 19/08/15, fn133; Personal communication, real estate dealers, Sangam Vihar, 06/02/15, Hindi, fn17. On spatial distribution of castes, personal communication with researchers working on caste and land use in Delhi - Tom Cowan, Kings University London; Swastee Ranjan, Jawaharlal University; Tarini Manchanda, South Asia University.
[88] (Sheik, Banda, et al., 2015)
[89] (A. Bhardwaj, 2014, 2015a, 2015b, 2015c)
[90] Personal communication, Ashish Bhardwaj, Sangam Vihar, 3/02/15, fn8

The dominant Gujjar caste from Tughlakabad village have been influential in local south Delhi politics since the State Assembly was created. The South Delhi MP (Member of Parliament) is a Gujjar from Tughlakabad village as are other political players and real estate dealers[91]. The MP, a BJP member, is credited with originating plans for better water supply to the area, as well as tubewell installation, and is said to have done 'lots for the village, electricity, roads, water' (Sharma, 2008)[92]. He has been the area candidate for the BJP since 1993, winning the MLA seat for Tughlakabad in three consecutive elections (2003, 2008, 2013) before becoming the BJP MP for South Delhi Constituency in 2014[93]. The MP is a well known in Sangam Vihar and said to have made his money 'in water'. Three relatives are MLAs or MLA Candidates in south east Delhi (Indian Express, 2015b). His predecessor and long-time rival, from the Congress party, the Tughlakabad MLA from 1993-2003, is also a Gujjar from the same sub-caste. This kind of caste dominance is not uncommon. The Chhattarpur MLA seat in south Delhi has rotated between close relatives working for different parties since 2008. The current Chhattarpur AAP MLA, (described as 'Delhi's richest candidate' – I saw eight luxury cars and a tractor in the drive to his opulent farmhouse in Fatepur Beri), had worked as a Delhi Jal Board Junior Engineer until 2005, and previously been a representative and candidate for other parties. In addition to their prominence in local politics and real estate in the Sangam Vihar area, Gujjar and Jaat people are said to be involved in water supply businesses serving the area's more recent residents[94].

> All the politicians are talking about water, electricity, streets, drains, but they do not give details they just say "give us your vote and we'll give you water [*vote do aur paani denge*]".
> (Personal communication, Aasha[95], Non-Governmental Organisation (NGO) Manager, resident, BJP-supporter (female, late-20s), Sangam Vihar, 16/01/15, Hindi and English, fn13)

[91] Personal communication, real estate dealer, from Tughlakabad village and related to the MP, Sangam Vihar (Tughlakabad side), 06/02/15, Hindi, fn17. As on Delhi's south western border Yadav's are also a presence in real estate circles. Personal communication, Tom Cowan, PhD researcher, Kings University London, November 2015

[92] Personal communication, urban researcher working in Badarpur area, 15/01/16, fn126. Personal communication, real estate dealers, including relative of Bidhuri's, Sangam Vihar, 06/02/15, fn17

[93] Ramesh Bidhuri leading protest against AAP water mafia - https://www.youtube.com/watch?v=Zl8yYNPEuIA

[94] Personal communication, party worker, Sangam Vihar, 9/07/15, fn93; personal communication tanker owner and SV resident, Saket, 16/08/15, fn115

[95] All names have been changed except journalists, researchers and politicians of MLA level and above

Water was a major element of the AAP election campaigns, and 'the water mafia' a foil of both the AAP and the previous Sheila Dikshit-led Congress government. Dramatic incidents involving water, like the tubewell taskforce, are fairly common (Sakorkar, 2014; The Pioneer, 2013; Zee News, 2015). In May 2014, the AAP MLA for Deoli led a *dharna* [peaceful sitting protests] outside DJB offices over lack of water supply for his constituency (The Hindu, 2014). Later in the year, the AAP MLA for Sangam Vihar was slapped by an irate woman in response to his enquiries about water. The South Delhi MP has also led public protests against 'the AAP water mafia'. At time of writing, the AAP MLA for Sangam Vihar had been jailed for a separate complaint, provoking Delhi's AAP Chief Minister, Arvind Kejriwal, to accuse Narendra Modi's BJP Union government of interference. Both Sangam Vihar's MLAs are Members on the DJB's Board of Directors, however their strengths on the ground differ (see *Tubewells* section below). The MLA for one constituency is older, and has a stronger crew with ward level 'youth leaders' (youth does not seem to be a requisite) and a large number of young men working for him at his constituency office. These local party workers seem to be quite close to *pradhans* and BJP workers – established neighbourhood power centres. The local AAP party has split amid accusations that MLAs are themselves continuing the 'water mafia' rent-seeking and patronage of their predecessors from other parties. Allegations of corruption in water supply have led to spectacular break-ups within the party at a city-level also (see page 18, footnote 9).

Until recently, the DJB supplied water to Sangam Vihar through tubewells and tankers only. This lack of piped supply left residents relying on a range of alternative supplementary sources, including the informal water economy associated with 'the water mafia'.

> 'Mafia' here is not like in your Western movies. It's not like in the Godfather! It means people that control the market. With tubewells this means people have captured the wells and control the prices. With tankers you need connections in the DJB to get them delivered. With private tankers it means that these people control the trade.
> (Personal communication, Ashish Bhardwaj, Ratiya Marg, Sangam Vihar, 3/02/15, fn15)

A friend, Asha, quoted above, told me that the reason her area could not get water was because of 'corruption'. 'People have been to ask the DJB guy about it', she said. 'He has bought ten machines but he only uses five of them. When people asked, he asked for money to use the other five'[96]. In a conversation on the other side of Sangam Vihar, a *pradhan*, Ram Kumar, and his friend also gave a story of corruption as behind the reason for the lack of authorisation for water supply. They said 'corruption in the water supply' was why 'the previous MLA didn't get the authorisation to extend DJB water to the area. This was because the DJB was taking money, and the MLA and the [Sub-Divisional Officer] also'[97]. 'Just like the DJB [staff] might ask for money [as a side payment] for a new connection, this was [a larger amount for] connecting a whole new area'. 'Tanker businesses are also there', they added significantly[98]. Returning to the topic of why Sangam Vihar couldn't get piped water from the DJB later in the conversation, Ram Kumar says that it was not that the previous guy didn't do the work but that it just took a long time. 'Actually the MP started the work ten years ago,' he said. This refers to the current MP while he was still an MLA. They both say that the previous BJP MLA 'didn't do work'. Ram Kumar, whose father was also a *pradhan*, told me that there used to be an NGO working there in his father's time that 'made improvements to the roads and the electricity and water and did education for children'.

> When the [Congress party] politician came in [mentioned on p143 above], the NGO had to go because they were doing people's work for free and the politician would say if you want work done you must give me money.
> (Personal communication, *pradhan*, Sangam Vihar, 03/07/15, originally Hindi, fn91)

Suspending judgement as to the truth of the allegations, I quote the excerpts above as an example of popular perceptions around water supply in Sangam Vihar. Formally, the lack of piped supply is determined at a higher level by a partially laid pipe network as much as administrative regulations. However, many residents felt that personal partiality of key politicians and officials, led to biased allocation of services. For example, in 2013, dissatisfied residents reported that as Deoli had elected an MLA from the ruling Congress

[96] Personal communication, local resident, Sangam Vihar, 6/11/14, Hindi and English, fn11
[97] Another respondent in a different site also said that the SDO was involved in corruption in water provision, personal communication, resident (male c.45), urban village (Hindu), south Delhi, 21/01/15, fn14
[98] Personal communication, *pradhan*, Sangam Vihar, 03/07/15, Hindi, fn91

party, they had been provided infrastructure but that as the Sangam Vihar MLA was BJP he was unable to get work done[99]. The MLA for Sangam Vihar at that time was described to me as 'water mafia' by AAP workers[100]. Similarly, a volunteer, Ravi, described the discretionary allocation of water by party workers:

> Before us the MLA was BJP […] He did some work, I will not say he did nothing, but on water issues he placed his people on the water sources. They consume water and sell water. They were making money from water sources. If you are living in Sangam Vihar you require water so pay me. It was black [money], ₹100 per month. If there is shortage, then water must be arranged from somewhere – you can't live without. Price could be ₹500-1000 for some reasons. [They would give or not give] – this one is BJP person, this one is not. They would have people on the pipelines, they are strong people in fighting mode so even if one [person] gets good water and other gets none they will not say anything because [they feel] 'he's our *neta* [leader]'. It was like this in the whole MLA area.
> (Personal communication, AAP party worker, Sangam Vihar, 18/05/15, Hindi and English, fn81)

MLA staff said that water is the most common reason for visiting the office,[101] and almost all the residents who came during the many times I was there were indeed asking for water or complaining that there was a problem with their water[102]. Both water tankers and tubewells are said to be closely related to the economy of party politics. Control over tankers is seen as one of the perks of MLA office, which is commonly used as a source of income or means of dispensing patronage to constituents. Patronage is also involved in the siting and speed of approval of tubewell requests by the MLA[103].

The 'renationalisation' of the 35 tubewells under the AAP MLA during the '49 days' brought tubewell network prices down, in those areas where the AAP had enough strength to be able to do it. This helped contribute to people's nostalgia and support for the AAP. Some people also said that the AAP people running the tubewells were discriminating against them and that this is why the AAP MLA got slapped[104]. The MLA himself described the incident as negative publicity deliberately generated by 'water mafia' (Akram, 2014;

[99] ('Deoli (Delhi Assembly constituency)', 2015; Vyawahare & Bearak, 2013)
[100] Personal communication, AAP workers, Ratiya Marg, Sangam Vihar, 16/05/15, fn81
[101] Personal communication, senior party worker, Sangam Vihar, 18/05/15, fn81
[102] cf Meeting with Chhattarpur MLA, 15/05/15, fn74.
[103] Personal communication, senior local BJP representatives, Sangam Vihar, 27/11/14, Hindi, fn125.
[104] Personal communication, national journalist, Ratiya Marg, Sangam Vihar, 3/02/15, fn8

Firstpost, 2014)[105]. This incident has continued to dog him, and at time of writing he had been jailed in response. These sort of accusations and counter-accusations are described as 'playing politics' in India, or simply 'politics', as in the MLA's quote at the start of the section (cf D. Singh, 2016; Times of India, 2016a; Daily News and Analysis, 2016). Differences between AAP workers and volunteers, and ongoing conversations amongst participants about the direction of the Aam Aadmi movement/party were obvious during my fieldwork. Residents have described tubewell capture as linked to the MLA's office (under previous governments) to other researchers also (A. Bhardwaj, 2015b; Sheik, Banda, et al., 2015).

Sign on right reads: In ward no. 177 Sonia Vihar water pipe line joining work by DJB courtesy of Aam Aadmi Party's popular MLA

Just as there can be competition to show up rivals, demonstrations of public work are also competitive and claimed by politicians to ensure that the public is aware of who has been responsible. Signs, banners and posters in Sangam Vihar and Malviya Nagar proclaim the advent of new 'Sonia Vihar' water lines with credit due to the MLA. This competition to be seen to be doing public service induces political representatives to operate outside the legal framework if it is in their constituents' interests. While spending time in the AAP office in Sangam Vihar, a senior worker, Kamal, who usually works in a different office, but lives in Sangam Vihar, showed me photos on his phone of a crowd and some people wearing marigold garlands and pipes. He told me it was a new water supply inaugurated yesterday

[105] Cf claims that both parties are selling water (Abhimanyu Singh, 2016)

in a different area. I ask about the tubewell and he says "No, I broke the pipes to give people water. It is illegal but I did it anyway for the people. I can go to jail it doesn't matter it will make a name". He takes a connection from the mains pipe illegally and then runs smaller lane pipes off this. He says he has done four or five of these[106].

Although the water situation in Sangam Vihar was different in different lanes, households use four to five different sources of water. For a household of five, water bills of over 3,000 rupees (£30) a month is quite likely across DJB and private tubewells, topped up with tanker water and 20 litre cans for drinking for those who can afford them. As the monthly household income of the one in six of Delhi's population who are Below Poverty Line was 3,060 rupees in 2005, it is likely that many people consume untreated water (Government of NCT of Delhi, 2009, p. 239).

> Tankers are supposed to give drinking water - this is how DJB justifies giving tubewell water - because it's not for drinking. Borewells are for everything else. (Personal communication, Aman Sethi, journalist, Defence Colony, Delhi, 02/06/15, fn86).

Tubewells, private tankers and illegal water factories all use groundwater. Extraction is cheap and hard to detect. These private sector suppliers also sometimes overlap with the public sector tankers and tubewells, meaning reduced water availability for low-income users who must rely on public sources. Tubewell networks are valued over tanker supply only[107], although many residents still require tankers to supplement inadequate supply. Groundwater is a sub-optimal solution; unclean, untreated (except in factories) and seasonally variable. Further, water levels are declining due to high extraction rates, resulting in lower quality water, and increased need for well re-drilling and pump repair (Kulkarni & Shah, 2015; Kulkarni et al., 2015). I first discuss tubewells (also known as borewells), then tankers, last bottled or 'canned' water.

[106] Personal communication, senior local party worker, MLA office, Sangam Vihar, 18/05/15, Hindi, fn81
[107] Focus group, residents, Sangam Vihar, 16/02/15, Hindi, fn24

TUBEWELL TERRITORIES

The first government tubewells in Sangam Vihar were installed by the DJB 'after 1991' (Kacker & Joshi, 2016, p. 260). In subsequent years residents petitioned the area MLAs for more tubewells. In 2013, the DJB listed 82 tubewells for the Sangam Vihar constituency, and 74 for Deoli. The quantity varied considerably across blocks, with just one reported in J-2, J-3 (Sangam Vihar) and M-1 (Deoli) and 11 in H (Sangam Vihar) and 15 in L (Deoli) (Sheik, Banda, et al., 2015, p. 5).

A tubewell is obtained by writing a letter signed by local residents to the MLA, who will then forward the request on to the DJB[108]. This introduces an element of discretion on the part of the MLA, speed of responding/ forwarding the request and the siting of the tubewell being the main parameters where variability of outcome is possible[109]. I was told that these requests as with other requests to the MLA could sometimes require several visits from the petitioner, and might not be forwarded from the MLA's office depending on the petitioner's relationship with him. 'Getting the signatures is not hard, but getting the MLA to accept the letter is hard'[110]. (Similar things were said about voter registration for slum dwellers in Malviya Nagar.) I was unable to find out why the MLA accepting the letter was difficult. When the MLA changes, the paperwork, for tankers, tubewells, roads, pensions, voter IDs etc, is abandoned and the process must begin again.

The MLA is not the only power-holder in the process of tubewell (or piped water) supply. Network water pipes were laid in Sangam Vihar in 2008, although it was another eight years before network water could be supplied[111]. To take another example, for tubewells, a No-Objection Certificate (NOC) is also required from the Sub-Divisional Magistrate (SDM) and it is DJB Junior Engineers and staff that will actually arrange and do the work. The MLA for one side of Sangam Vihar told us that he had not been able to spend his discretionary budget of forty million rupees for that year, plus thirty million unspent from the previous office holder, as he had difficulty both in persuading the DJB to do his work, and with

[108] Personal communication, party workers at MLA office, 18/05/15, fn81; Personal communication, *pradhan* and ex-municipal counsellor, Kapasevra, Delhi, 2015, Hindi, fn33
[109] Personal communication, senior local party leaders, Sangam Vihar L1st, 27/11/14, fn125
[110] Personal communication, NGO manager, Sangam Vihar, 17/06/15, fn87
[111] Personal communication, Aman Sethi, journalist, Defence Colony, Delhi, 02/06/15, fn86

popular support ('strength on the ground') to get it done. He had managed to install only six new tubewells during the 49 days. In contrast the MLA for the other side got 18 new or re-bored tubewells done in the 49 days across six blocks[112]. However, the MLA's fortunes appeared to have reversed over the following years (see pages 147, 165).

Commonly, general domestic water is sourced from tubewell *networks* (public / private) and tankers. Many households use both DJB and private tubewell networks. For a tubewell network, a submersible pump is sunk at depths from 350-600 feet, connected to electricity and an operating terminal and pipelines are laid from the above ground unit into different lanes and houses. The DJB installed tubewell networks usually cover three to five lanes of 100-200 households each, but users and operators I spoke described networks ranging in size from 20 to '300-500 [houses] minimum'[113]. The network owners may also add additional households onto the network; for example, if houses are extended vertically with an extra floor for rent. The pump is operated as often as necessary to supply water to connected houses for a fee.

In some blocks government tubewell networks supplied water to each house for an hour a day[114]. However, most networks are oversubscribed, and many people said that the government tubewells gave them water once or twice a month[115]. In areas towards the edge of the colony, supply was less frequent and people might get water once in five to six weeks or two months[116]. For oversubscribed networks, pumps will be running twenty-four hours a day but water is still insufficient[117]. As Tej, a local resident, told me, people cope

[112] Personal communication, MLA, 10/11/14, fn12; Personal communication, senior local party worker at MLAs office, 18/05/15, fn81
[113] Personal communication, local residents, NGO office, Sangam Vihar, 16/02/14, fn21; Personal communication, *pradhan* and *kholnewala*, Sangam Vihar, 16/02/15, fn48; Personal communication, AAP party workers, Sangam Vihar, 18/05/15, fn81
[114] Personal communication, former party worker, Sangam Vihar, 18/12/15, fn132
[115] Personal communication, resident (female, c.55), 6/11/14, fn11b; Personal communication, Ashish Bhardwaj, Sangam Vihar, 3/02/15, fn15; Personal communication, residents (male, c.20 &25), 04/02/15, fn16b; Personal communication, real estate broker, (male, c.40), Sangam Vihar, 06/02/15 fnF17a; Focus group, residents, Sangam Vihar, 16/02/15, fn24; Personal communication, resident (female, c.30), Sangam Vihar, October 14, fn47; personal communication, health worker and resident (male, c.25), Private Hospital, Sangam Vihar, 16/05/15 fnF75; Personal communication, AAP party workers, Sangam Vihar, 18/05/15, fn81
[116] Focus group, residents, Sangam Vihar, 16/02/15, fn24; Personal communication, tanker owner, Sangam Vihar resident, Saket, 16/08/15, Hindi, fn115
[117] Personal communication, *kholnewali*, Sangam Vihar, 16/02/15, Hindi, fn23

with little water by using less, 'they bathe once in two days, if water doesn't come, maybe once in two or four days'[118]. Supply frequencies depends on the number of connected households, the power of the pump, the depth of the well, and any additional use by the tubewell owners (for example, filling tankers for sale, see section on *Tankers* page 163 below).

In 2016, there were 165 government tubewells in Sangam Vihar. Using population data from (A. Bhardwaj, 2015a) this averages one tubewell for every 6,000 residents. Tubewells in the Sangam Vihar area can yield over four thousand litres an hour, or 100 thousand litres a day (Centre for Science and Environment, 2010). Using these yields (Centre for Science and Environment, 2010, pp. 4–5), if all wells were running 24 hours a day this would give 36 litres per person per day – below WHO minimum household requirements (Gleick, 2000, p. 11).

When the area was first settled, residents could find water at thirty feet with hand pumps, however now borings at least 650 feet deep are required[119]. Several interviewees mentioned the declining groundwater level[120]. In some areas people said that the increase in population had led to lower water availability[121]. Declining groundwater levels means that households connected to a tubewell network have to share a decreasing amount of water. As the tubewell motors are running 24 hours a day there is an absolute limit on the quantity of water available[122].

In many parts of Sangam Vihar groundwater levels have reached the limit of viable extraction. What remains is increasingly 'hard'[123] and not worth drinking. Network managers recognise that the water table is falling and is causing problems for the tubewell

[118] Personal communication, party volunteer, Sangam Vihar, 9/07/15, Hindi, fn93
[119] Personal communication, local party worker at MLAs office, Sangam Vihar, 18/05/15, fn81; Personal communication, senior local BJP representatives, Sangam Vihar, 27/11/14, Hindi, fn125
[120] Personal communication, residents (male, c.20 &25), 04/02/15, fn16b; Personal communication, private tubewell owners, Sangam Vihar, 04/02/15 fn16c; Personal communication, *pradhan* and *kholnewala*, Sangam Vihar, 03/07/15, fnF91;
[121] Focus group, residents, Sangam Vihar, 16/02/15, fn24; Personal communication, *pradhan* and *kholnewala*, Sangam Vihar, 16/02/15, fn48
[122] Personal communication, *kholnewali*, Sangam Vihar, 16/02/15, fn23; Personal communication, *pradhan* and *kholnewala*, Sangam Vihar, 16/02/15, fn48
[123] *khada* - hard / bitter

supply[124]. This kind of water is also damaging for submersible motors, as it is heavily saturated with sand and gritty particles which erode the blades of the pump, 'like sandpaper'[125]. This dramatically shortens the lifespan of a submersible pump (from 2-3 years to maybe six months), consequently repairing government tubewell pumps which have broken is a daily activity for municipal subcontractors[126]. This diminishing quantity of water also leads to quality issues. I vividly remember being shown some water that had been left standing for two days and had 'gone bad' [*kharab ho gaya*]. It had light brown particles floating in it. They looked like feathery shit[127]. The decline in water tables also increases pressure on the network managers who must distribute water among, and collect payment from, households. One manager I spoke to had quit the job as complaints over the decreasing amount and quality of water were more than she could stand[128].

Households pay monthly fees for a connection to a government tubewell network. These are officially 50 rupees, but up to 200 may be charged by the network manager[129]. Private networks charge more; some people said they only paid ₹50, but more commonly amounts of ₹250-700 were quoted. As the tubewell water is not treated for drinking, everyone who can afford to buys 20 litre plastic cans of drinking water (see section on *Bottles, Cans and Factories*, page 117).

The quantity and pressure of tubewell water is limited, and the water is supplied in a rotating fashion, described as 'serial', to the pipes for different lanes and houses. This is common in rural tubewell use (e.g. T. Shah, 2008, p. 11). However, while rural tubewell rotations are said to provide 'timely' water supply 'discipline', urban tubewell supply was frequently described to me as random and unpredictable (Dubash, 2001, pp. 190, 218). The

[124] Personal communication, *pradhan*, 03/07/15, Sangam Vihar, fn91
[125] Personal communication, Water Pump Dealer, Malviya Nagar, 21/08/15, fn135
[126] Personal communication, workers re-boring tubewell, Sangam Vihar, 16/02/15, fn19
[127] Observations, transect walk with local resident, Sangam Vihar, 6th November 2014, fn11
[128] Personal communication, *kholnewala*, Sangam Vihar, 18/02/15, fn23
[129] Timings and prices from: Transect walk and conversations with local residents, Sangam Vihar, 6th November 2014, fn11; transect walk and conversations with local resident, Sangam Vihar, 04/02/15, fn16; Personal communication, local residents, NGO office, Sangam Vihar, 16/02/14, fn21; Personal communication, *kholnewali*, Sangam Vihar, 16/02/15, Hindi, fn23; Focus group with local residents, Sangam Vihar, 16/02/15, fn24; Personal communication, resident (female, c.30), Sangam Vihar, October 14, fn47; Personal communication, *pradhan* and *kholnewala*, Sangam Vihar, 16/02/15, fn48; Personal communication, resident (female, c.30), BJP supporter, 17/06/15, fn87

rotational tubewell supply requires manual intervention to open and close the valves to different pipes. The person responsible for opening the valves for different lanes and houses is called the *paani kholnewala* ('water opener')[130]. This person was also referred to as the *paani malik* ('water owner'). Drinking Mountain Dew in their small party office, Ravi and other AAP party volunteers described the *kholnewala* system to me: 'Fifty to a hundred rupees is collected for the water by a local person. One bore is for minimum three to five hundred homes. Two persons may do the *kholnewala* work also. They make about eight or seven thousand rupees a month, which includes maintenance'. I did some maths; 500 x 100 = 50,000 per month! 'Water might come once in ten days, fifteen days, once a month. The problem is not only where to store enough water for two weeks or a month - people don't have enough space - but also that it will 'go bad' [*kharab ho jaega*][131]. So for drinking they *purchase* [English word used] 20 litre cans for ₹20-25'[132].

I met several *kholnewalas*. They often had a connection to the area *pradhan*, an informal local leader, if they were not themselves a *pradhan* (see p77). The role gives operators who are socially powerful control over the network and the ability to divert water for personal use, patronage or profit as well as generating a considerable income[133]. While some *pradhan*s (like Shiv below), were themselves *kholnewala*s, in other areas, the *pradhan* might own the well (like Viraj and Ram Kumar), but the job had been subcontracted to others[134]. In some areas it seemed that the *kholnewala* post and tubewell rates were connected to the *pradhan sabha* [*pradhan*'s meeting] and its 'members' to which other residents were not

[130] Personal communication, resident (female, c.55), 6/11/14, fn11b; personal communication, residents (male, c.20 &25), 04/02/15, fn16b; personal communication, former kholnewala, 18/02/15, fn23; Focus group with local residents, Sangam Vihar, 16/02/15, fn24; Personal communication, kholnewala and pradhan, 16/02/15, fn24b; personal communication, residents (female, 35,45,55), 2/05/15, fn66; Personal communication, AAP party workers, Sangam Vihar, 18/05/15, fn81; Personal communication, resident (female, c.30), BJP supporter, 17/06/15, fn87

[131] As in the three days old water with things growing in it! Fieldnote 11, page 102 above

[132] Personal communication, local party worker at MLAs office, Sangam Vihar, 18/05/15, fn81

[133] Similarly, in another site, Datta describes a conversation with residents who describe the local people subcontracted to manage the privatised electricity distribution as 'ruffians' who 'ask for bribes and terrorize the people' (Datta, 2012, p. 103). For discussion of this informal electricity connection subcontracting in Sangam Vihar see (Das Gupta & Puri, 2005).

[134] Personal communication, local resident, Sangam Vihar, 16/02/15, fn22; Personal communication, *kholnewali*, Sangam Vihar, 16/02/15, fn23; Personal communication, *kholnewala*, Sangam Vihar, 16/02/15, fn24; Personal communication, p*radhan,* Sangam Vihar, 16/02/15, fn48; Personal communication, *kholnewali*'s relative, 17/02/15, fn26; Personal communication, AAP party workers, Sangam Vihar, 18/05/15, fn81; Personal communication, NGO manager, Sangam Vihar, 17/06/15, fn87

always welcome[135]. Tubewell managers are also often associated with a political party or have party connections, but as more than one of my informants told me: "everyone has some political connections, contacts. That doesn't mean they are partisan. It's just that you need political connections to get by'[136].

Sangam Vihar streets

I sat with Ram Kumar, a *pradhan*, in his marble hall (*Chapter Four*) with Bhalli, an AAP volunteer, drinking tea and Mountain Dew (again) and asking about local history and water in his part of Sangam Vihar.

> Most people are on private borewell networks as DJB water doesn't come. These cost around 6-700 rupees per month. The water is not for drinking just washing clothes and cleaning etc For drinking most people buy the 20 litre cans. The water from the ground is very hard. DJB tankers *do* come. […] The water is 800 feet deep, tubewells a thousand. But the water is still not good. It has little things in it - stones, dust and dirt [Ram Kumar and Bhalli agree enthusiastically when I suggest *dhool,* the Hindi word for dust]. This gives people kidney problems. It also breaks the electrical parts in RO [reverse osmosis] filters because it is salty. So they will last about a year, maybe only six months. It is a *negotiation*, a *compromise* [English words used] […] the water is going down every day.
> (Personal communication, p*radhan* and tubewell owner, Sangam Vihar, 03/07/15, Hindi, fn91)

I met Shiv, a *kholnewala* and *pradhan*, outside his house in an area near the far edge of Sangam Vihar. He looked in good form and seemed about 40, fit, with well-groomed short

[135] Focus group with local residents, Sangam Vihar, 16/02/15, fn24. A young girl in red mentioned a *pradhan sabha* meeting that they were not allowed to go to, but the older people present hushed her. Discussion with kholenwala, residents and *pradhan* (female), Sangam Vihar, 11/11/14, fn11.
[136] Personal communication, Ashish Bhardwaj, Sangam Vihar, 3/02/15, fn15 cf (Manish, 2013)

hair and mustache, and wearing a clean, white shirt and slacks. We sat on the bench in front of his house, which had a curtain across the doorway and some potted plants in front. This area was pleasant, on a slope and quite breezy, not too built up, with nice, varied houses and some other plants around. It was not too busy and had a relaxed feel to it. Shiv said he has been the valve guy since the well got put in. He told me that 'In other areas government men would do this work but they cannot in Sangam Vihar' (cf Ghertner, 2017)[137]. He said he collects 50 rupees from each house for his salary. He supplies three hundred houses so this makes 15 thousand rupees a month, a good salary. The tubewell has a 'light box' nearby which he has the key to. Inside is a big on button and off button. There is also an electricity meter which didn't seem to be working. Shiv said that this was a 'prepay' meter and that the DJB controlled it somehow. I asked if he had to give money to the DJB or anything, but he said 'no'. The main thing was the on and off switch. The tubewell had six pipes coming off it and there were small rectangular valves which could be opened or closed with an allen key. These main valves would give the water to the different lanes – there is one for each lane. Then the lanes also have valves for each group of six houses. Shiv would open and close the valves to give water to the whole area. He got the job because his father has some government job and heard about it and they went to see the DJB and some leader/ politician ('*neta*'] and then the DJB again. Then when they got a tubewell he got the job of looking after it. I asked if people ever complained to him about the water because I had heard people say that in other areas they complained about the valve people but he said no, they didn't. There was enough water for their area so it wasn't an issue here[138]. Other *kholnewalas* also said that people did not complain (see Kacker & Joshi, 2012) (F24b, 48). Indeed, asking after the *kholnewala* could turn unhappy stories of bad water and neglect into firm assertions that there was no problem with the water (F66). In other areas, even the idea of complaining to the *kholnewala* was something quite novel:

[137] Ghertner describes the situation of government *kholnewala*'s performing apparently illegal groundwater extraction. However, groundwater extraction is not illegal is the government has demonstrated a failure to provide. The metaphor of a Mobius strip where actions are simultaneously inside and outside of the state, is therefore misapplied. The kholnewala's Ghertner describes are acting within government mandate, just as the kholnewala role in Sangam Vihar has been outsourced to local people (and may have been captured also)

[138] Personal communication, *kholnewala*, Sangam Vihar, 16/02/16, fn24

> I asked the ladies if they could talk to the 'water managers' [*paani maliks*] when there was a problem and it was kind of awkward and I looked at Aasha and she said 'no, no it's not like that'. Again when I asked who they could go to for help when there was a problem the same thing happened. One lady said that they would sort it out by themselves collect the money and get the work done, repairs to the pump or whatever it was. […] Later we met Meena, the *pradhan* of the road by the mosque. She has been working for the community for 30 years she says and the BJP the same time. When she heard about the guy asking rs150 for the rs50 DJB charges she said "let's go there now and talk to him". When we arrived a group of women, mainly those who had been in the temple before, came up. The guy looked sheepish. He was saying "It's not me, the members set the rates". But the women were saying "It's not right!" Meena was saying "It's my name on the pump". We arranged to meet the MLA to discuss it later. Meena clearly outranked him and everyone knew it. […] The women were all telling him off and complaining at him and he was saying "what can I do?"[139] I did some sums and realised if there are 100 houses each paying ₹100 a month that makes ₹10,000 [£100] - quite a lot of money in India and enough for the guy to live on. […] The women in the temple and the BJP *pradhan*, Meena, agreed that leaders and politicians are only interested when it comes to elections - then they say "give votes and we'll give water".
>
> Observations, Sangam Vihar, 6/11/14, fn11

Other residents also told me they have to collect the expenses for repairs themselves. The amount of water received from these public tubewells varies, depending on how many houses are connected to the network, depth of the bore and quality of the well, as well as the time of year (whether aquifers are depleted or recharging), electricity availability and whether the water is being used for any other purpose - such as filling water tankers for private sale. People typically say that water comes between once in two weeks to once in six weeks in the summers for between twenty minutes to two hours at a time[140]. Timings are not predictable, although in some areas the *kholnewala*s may let the street know when they are turning the water on. Sangam Vihar's quartzite geology, which makes well yields unpredictable and much lower than areas above alluvial aquifers, is corroborated by residents. Tej, a party worker, who lives in the 'Bihari Camp'[141] area on forest land told me

[139] Cf female kholnewala unable to respond to residents' complaints also
[140] Personal communication and focus group discussion, residents, Sangam Vihar, 16/02/15, fn24
[141] Rajasthani Camp

that it was only possible to dig for water up to a certain depth, after that 'black stone is there and you can't get water underneath it'[142].

Kholnewalas appear to be a pragmatic solution at the edge of the formal utility. *Kholnewalas* described themselves as employees of the DJB Junior Engineer and said that the DJB paid for the electricity but did not collect revenues (F24b, 48). This pragmatism may be related to the 'capture' (*kabza*) of government tubewells by powerful people (F15, 81, 117)[143]. As described above, some people said this was done by the dominant castes in the villages who had owned the land, and are now well represented in local politics and real estate (Kacker & Joshi, 2012, p. 31)[144].

> [Capture] of tubewells is by [villagers] they sell it to [people from outside], from UP [Uttar Pradesh], Bihar, Rajasthan, Bengal. The migrants cannot say anything. The tubewell people are charging 500-600 a month […] The tubewell people have a committee 'R[esidents] W[elfare] type' headed by the *pradhan* [leader] so people cannot say anything, cannot complain. They pay 500-600 a month. Eventually [it] all boils down to money - what's the other incentive?
> (Personal communication, tanker owner, Sangam Vihar resident, Saket, 16/08/15, Hindi, fn115)

*Kholnewala*s in a less stable social position may find themselves facing dissatisfied customers. I interviewed another (female) *kholnewala* at a friend's house, at her home and over the phone. She described her network to me like this:

> The pump […] is running 24 hours. […] It must give 6,000 rupees a month, so ₹200 a day. Before I took it over it was run by eleven men. […] The water is not for drinking but manual / daily wage workers [*mazdoor*] do [drink it]. The wells are 450 feet deep. People need clean water. […] Now they buy [cans] from shops for twenty rupees. These come from Faridabad. […] I am getting too many complaints the water is late, so now I have given the job and keys to someone else. This is to

[142] Personal communication, party worker, 9/07/15, Hindi, fn84. This area also described as stony and hard to bore for water by another respondent (Personal communication, *pradhan*, Sangam Vihar, 03/07/15, Hindi, fn91)
[143] Personal communication, Dunu Roy, Hazards Centre, Munirka, 21/08/14, fn4; Personal communication, resident (female, c. 30), BJP supporter, 16/01/15, fn13; personal communication, property dealer, RTI activist (male, c.45), Khirki Gaon, 21/01/15, fn14b; personal communication, residents (female c. 18, 25, 35), MLA office, 18/06/15, fn82; personal communication, AAP volunteer (male, c.21), 18/05/15, fnF83
[144] Personal communication, party worker, Sangam Vihar, 9/07/15, fn93

> show that it is not because I was late to open the water but because the water is going down.
> (Personal communication, *kholnewali*, Sangam Vihar, 16/02/15, Hindi, fn23)

Tubewell water is clearly less than ideal, and many people told me that they needed and *should have* 'Sonia Vihar water', meaning treated network water. The fact that Delhi's only Water Treatment Plant built through a Public Private Partnership (PPP) model is the most commonly used phrase to refer to treated network water is a curious side-point.

In addition to the government tubewell networks, Sangam Vihar is also well supplied with private tubewell networks. Although in some areas people do have private household tubewells, most people in Sangam Vihar don't have tubewells in their houses. A tubewell inside a house could make it very hard to fit or to repair the submersible pump or make the well deeper as the house would get in the way of the tripod[145]. People used to have tubewells in their houses but the water ran out at that level.

> [Around 1993] there were bores in some houses, but those old bores, the water quantity got over. The water level has gone down now. Mostly bores are in the street. Some of the older bores may be in people's houses or courtyards but they have mostly run out. The water table is at 650-700 feet so the water is finished.
> Personal communication, AAP party workers, Sangam Vihar, 18/05/15, Hindi, fn81

As mentioned above, some people with bigger plots have wells inside their courtyard from which they supply neighbouring houses - I met a wealthy friend of a BJP politician on Ratiya Marg who does this[146]. Private tubewell networks may serve just a few houses, or may cover several lanes and hundreds of households. Most of those I have seen tend to be the larger kind. However, most often in Sangam Vihar, 'private wells' are government wells that have been 'captured' by local power holders[147] (see p81 above). Fees charged by captured networks are much higher, anywhere from ₹150-500-800 per month, although the quantity

[145] See photographs of tubewell reboring (conversation, NGO Manager, Sangam Vihar, DATE?). However, there may be other methods of reboring: 'I have been in a house when one was being rebored. Tubewells can be rebored inside a house, they are always being rebored. Because the water level is going down all the time' Personal communication, PPP staff, 21/04/15, fn55
[146] (Conversation, businessman, Ratiya Marg, Sangam Vihar, DATE?)
[147] Personal communication, NGO Manager, Sangam Vihar, 16/01/15, fn13.

and quality of water is just as bad as the public networks[148]. Amongst residents, there seems to be ambiguity over whether specific bores are public or private - people could tell you whose bore it was, but not whether it was 'public' or 'private'[149]. Public bores are 'captured' by local people and then operated as private bores (cf the water mafia in previous section). Private and government tubewells can be distinguished by their government serial numbers. AAP can locate [*talash*] them because 'AAP has so many volunteers - they give us info, bores are in the roads, in the streets'[150].

There are an estimated 200 private tubewells in the Sangam Vihar and Deoli area[151]. They are more expensive than government tubewells, but do not supply water any more regularly; again from once in 10-12 days to once in six weeks[152]. Many residents I spoke to were connected to both government and private networks. Prices for private networks varied from five to eight hundred rupees a month[153]. Other research has found confusion over whether tubewells are DJB or private, and some interviewees also described 'private' wells as those that had been captured[154]. However the operators charge different prices (50-200 rupees for DJB, 500-800 for private) and DJB tubewells have an identification number in the control box (cf Kacker & Joshi, 2012; Sheik, Banda, et al., 2015)[155].

Interestingly, one respondent described tubewells as being part of real estate investment strategies in Sangam Vihar. Sangam Vihar's land prices are artificially inflated and used as a destination for black money generated throughout the city.

[148] Sheik et al give a much higher figure of ₹1,000-1,500 per month. Prices, quality and quantity of water are likely to vary depending on who is managing the tubewell. (Sheik, Banda, et al., 2015, p. 5)
[149] cf (Sheik, Banda, et al., 2015, p. 5).
[150] Personal communication, party worker, Sangm Vihar, 18/05/15, Hindi, fn81.
[151] Personal communication, senior local BJP representatives, Sangam Vihar, 27/11/14, fn125
[152] Transect walk and conversations with local residents, Sangam Vihar, 6th November 2014, fn11; transect walk and conversations with local resident, Sangam Vihar, 04/02/15, fn16; Personal communication, *kholnewali*, Sangam Vihar, 16/02/15, Hindi, fn23; Focus group with local residents, Sangam Vihar, 16/02/15, fn24; Personal communication, *pradhan* and *kholnewala*, Sangam Vihar, 3/07/15, fn91; Personal communication, tanker owner, Sangam Vihar resident, Saket, 16/08/15, Hindi, fn115
[153] Personal communications, local residents, Sangam Vihar, 06/11/14, fn11; Personal communication, residents (male, c.20 &25), 04/02/15, fn16b; Personal communication, local residents, 03/07/15, fn91; Personal communication tanker owner and SV resident, Saket, 16/08/15, fn115
[154] Personal communication, resident (female, c. 30), BJP supporter, 16/01/15, fn13; Personal communication, Ashish Bhardwaj, Sangam Vihar, 3/02/15, fn15
[155] Personal communication, AAP party worker, Sangam Vihar, 18/05/15, fn81

> 'Agrawal alleges that sale and purchase takes place mostly among "big fish" for whom it is an avenue "to conceal black money". "You cannot keep crores[156] in cash at home," he explains. "Once the colony is authorised, their land and black money would be automatically legalised. They are waiting for that moment."' (A. Bhardwaj, 2015c)

As land values fluctuate depending on the likelihood of regularisation, investors were said to play land investments in Sangam Vihar 'like a stock market'[157]. My friend Sanjay and I met a tubewell manager who took us to meet other water suppliers working in a small tailors' workshop with large, locked, water plastic water tanks outside, at the end of a small lane of old, low-rise buildings deep inside the block. Sanjay told me that 'the [tubewell manager] works for a real estate broker. He manages the water for him. He was nervous because he didn't want to say anything. The real estate brokers control tubewells and they buy and sell the wells amongst each other. It is a sort of game, a monopoly game'[158]. This conversation after meeting with water suppliers and several other residents in the block, hints at overlap between networks in real estate and water, possibly (Gujjar) caste-based.

> Tej says that 'the BJP capture the bore wells and sell the water, it's a mafia'. He also says that Gujjar people (and Jaat - but when pressed, Gujjar) are the ones selling water. I ask what will happen - what they will do when the Sonia Vihar[159] water comes because they won't be able to take money for this anymore. He says they will sell milk or property.
> (Transect walk with AAP party worker, Sangam Vihar, 9/07/15, Hindi, fn93)

Both local party workers and residents described how the AAP 'renationalisation' campaign had only a limited life and bores moved back into 'private' hands, with the difference that the electricity costs of pumping the water were now being paid by the government[160]. Echoing Ravi's disclosure that the tubewell had been 'recaptured', a tanker owner and local resident also commented on the resilience of these local power dynamics.

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[156] A crore is ten million
[157] Personal communication, real estate dealers, Sangam Vihar, 16/05/15, fn76
[158] Fieldnotes, transect walk with resident, Sangam Vihar, 04/02/15, fn16
[159] Sonia Vihar is the Water Treatment Plant constructed by Degremont under a PPP mode for the DJB. People are very familiar with the name and the term 'Sonia Vihar *paanii*' is often used as a synonym for 'piped, treated DJB water'. For its relationship to the PPP projects in water distribution see Chapter 6.
[160] Personal communication, AAP party workers and local residents, 30/05/15, fn85; Personal communication, tanker owner, Sangam Vihar resident, Saket, 16/08/15, Hindi, fn115

> There was a big fuss about AAP capturing tubewells - 33 of them - in the 49 days. They brought DJB vehicles and the police so people were afraid but slowly slowly it went back to the same people and now it is the same except that now they get free electricity! Before the people were paying for the tubewell electricity themselves, but they installed meters so that the government could pay, so now they get free electricity!
> (Personal communication, tanker owner, Sangam Vihar resident, Saket, 16/08/15, Hindi, fn115)

A young AAP volunteer, Ravi, took me to his street to see his house and the tubewell in his lane he was talking about. When we arrive in his lane he shows me the bore which is buried under a square metal lid in the street. It is a submersible and the wire takes electricity to it. The box is a little way away, around the corner. There are about six large pipes coming off the junction and a slightly smaller one on the end. Ravi says 'You asked earlier if people that were party supporters got better water… That end pipe goes to this one house only - it is a BJP supporter's house'. There are four pipes, each supplying a lane of houses, and a fifth pipe leading to the BJP supporter's house. He gestures towards a large four storey house taking up an entire plot. Ravi's house is diagonally opposite, two storeys with exposed brickwork. His mum is doing some washing on the roof. 'The BJP guy was earlier doing the kholnewala. These *kholnewala*'s are just gangsters', Ravi says. 'The people with power will take the job, but we took over in the 49 days. Now he is doing it again but in 3-4 days I will be doing this job [..] There are many *pradhan*s. You could even say I am a *pradhan*! There will be one for each party in an area'[161]. I wasn't convinced that the young volunteer, Ravi, would be able to dislodge the BJP *kholnewala* from the role in the next 'three [or] four days', especially after being told that while campaigning, he had been attacked by BJP workers 'in fighting mode'[162]. Violent incidents are not uncommon and two friends of mine have been attacked by BJP workers. In January 2015, the AAP released a video which shows BJP workers (including one of my interviewees) and relatives of the MP, attacking AAP supporters with sticks and metal bars during filming of a TV show in a local park (Aam Aadmi Party Faridabad, 2015; Indian Express, 2015a; Times of India, 2015).

Control over tubewells was used as an income source by placing lower level party workers in charge of collecting fees over the mandated ₹50 that the DJB stipulates. After a small

[161] Transect walk with local AAP volunteer, Sangam Vihar, 18/0515, fn83
[162] Personal communication, party worker, Sangam Vihar, 18/0615, fn83

deduction of around ten percent as a 'salary' the money collected, which could be from fifty thousand to two hundred thousand rupees per month[163], was sent to higher party workers to cover the costs of elections[164]. The amount deducted as a salary matches the wages that *kholnewala*s in other blocks of Sangam Vihar have said they are paid. Ritesh, who was working closely with AAP in Sangam Vihar said that while management (including collecting fees) by party workers continued under the AAP government it was 'much less' than before. This accusation of continuing extraction of rents through water has also been made by another party worker and led to a split within Sangam Vihar AAP (Abhimanyu Singh, 2016).

'Captured' tubewells, Sangam Vihar. The well on the right has pipes for four lanes and a personal connection for a local party worker's house

ROAMING WATER TANKERS

The relationship between tubewells and tankers was revealed most forcefully one day when I was talking about bore well capture (*kabza*) with my friend Aasha in her office. 'Private wells are wells that have been captured', she says. 'For example, the well outside the building is the organisation's well'. There is a tanker filling up from this well as we speak. 'But Viraj owns the well now,' Aasha continues. Viraj is the area *pradhan* we met on page 136. Aasha makes a brief, slight, slightly humorous facial expression of unhappiness (meaning 'but what can you do?') when she says this. Viraj, the *pradhan*, lives in a large

[163] 300-500 houses paying ₹150-500 each
[164] Personal communication, former party worker, 18/12/15, fn132

house diagonally opposite the building we are in and has a small office across from his house. Aasha lowers her voice, 'the tankers that you have seen outside are not emptying sewage, they are filling [up with] water from the well'. We are talking fairly freely while the tanker is filling and the tanker driver comes into the office once or twice, I think to get a key for the well and put it back. I have seen these 10,000 litre tankers on most visits[165].

This situation demonstrates some of the overlap between the tubewell economy and tanker businesses. Because the water supplied from tubewell networks is limited residents will use both public and private tankers. In the same conversation I was told that during the summer the problem is greater as there is less water in the ground and so nothing is left for residents after tankers have been filled.

Two types of tankers ply in Delhi; public and private. Public tankers are operated by the DJB, although the vehicles and their drivers are hired in from three large companies (Lalchandani, 2015a; The Indian Express, 2017a). DJB tankers supply treated water from DJB filling stations. They come in two varieties; 'scheduled' (or regular) and 'emergency' (or 'point'). Private tankers are owned and operated by small companies, of which there are hundreds in the city; in 2002 the Water Tanker Owners Association suggested 250 (Daga, 2003, p. 176). In 2011, Centre for Science and Environment estimated that there were over 2,000 small private sector businesses involved in Delhi water supply with an approximate turnover of four billion rupees (Narain, 2011, p. 55). Private tankers almost always have a phone number on the side, and will deliver water for domestic use on order. The Central Ground Water Board has 'banned' the sale of water through private tankers (Delhi Jal Board, 2000, p. 27, Resolution No. 693, Item 700). According to common belief, although the transport and commercial sale of water is not illegal, the methods used for obtaining water are very likely to be illegal. It is possible that the water is groundwater from out of state, indeed this is what drivers often say[166], however, the distances involved would make this commercially unviable[167].

[165] Observations, Sangam Vihar, 16/01/15, fn13

[166] Personal communication, tanker driver, 16/10/15, Hindi, fn119; prices from transect walk and conversations with local residents, Sangam Vihar, 6th November 2014, fn11; Personal communication, local resident, Sangam Vihar, 16/01/15, fn13; Transect walk and conversations with local resident, Sangam Vihar, 04/02/15, fn16;

Water tanker, private

Water tanker, DJB hired

Tankers can frequently be seen driving, or being pulled by tractor, through the narrow lanes (causing traffic jams), parked outside of houses making deliveries, or simply standing idle waiting for an order. This makes them more obvious than tubewells. (Indeed, one academic who claimed to have been working in the area for 18 months was not aware that Sangam Vihar used tubewell water.) Many tankers, public and private, are often parked, along with septic (or 'safety tank') trucks on the main road between Deoli and Sangam Vihar (10-15 total including DJB and private on any given day) and on the main road outside Sangam Vihar.

At time of writing, the DJB runs a tanker fleet of 957 vehicles. 407 are stainless steel tankers fitted with Geographic Positioning System (GPS) location monitoring, 250 are stainless steel purchased in 2016 and deployed in the areas of the PPP pilots, and 300 are older mild steel vehicles (Halder, 2017a). The GPS monitoring system is run by Delhi Integrated Multi-Modal Transit System (DIMTS). However, DIMTS only provides the information to the DJB and the DJB does not employ the tanker drivers. DJB tankers are hired in (with staff) from three large companies – the source of ongoing corruption allegations (Lalchandani, 2015a; The

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Personal communication, local residents, NGO office, Sangam Vihar, 16/02/14, fn21; Personal communication, *kholnewali*, Sangam Vihar, 16/02/15, Hindi, fn23; Focus group with local residents, Sangam Vihar, 16/02/15, fn24; Personal communication, resident (female, c.30), Sangam Vihar, October 14, fn47; Personal communication, *pradhan* and *kholnewala*, Sangam Vihar, 16/02/15, fn48; Personal communication, resident (female, c.30), BJP supporter, 17/06/15, fn87

[167] Personal communication, Aman Sethi, journalist, South Delhi, 2/6/15, fn86

Indian Express, 2017a). Pursuing complaints against individual staff would be difficult for the DJB whose leverage with the tanker companies would only be available on the renegotiation of the contracts. The AAP government took the important step of making tanker GPS information available to the public online in 2015 (The Indian Express, 2015). However, for Sangam Vihar, the point is moot as no GPS-equipped tankers ply in the area.

DJB tankers do deliver to Sangam Vihar, but are not reliable. Researchers at the Centre For Policy Research state in an article on Sangam Vihar that they have never seen a DJB tanker in Sangam Vihar (Sheik, Banda, et al., 2015, p. 5). While private tankers are more numerous DJB tankers do also ply and I have seen them often. In discussion with residents from across different streets (also religions and income levels) in the block it became apparent how wide differences are in water availability. While residents from one street said that tankers came twice a day from the DJB to 'outside the house only', another street said that they came once a week and gave 200 litres per person, while Church colony residents said that tankers would not come[168]. DJB tankers don't ask for money but residents give the drivers ₹10-20 as a *chai-panni* [tea and water] tip.

The process to get a water tanker delivered – either scheduled ('point') or emergency – is that residents must write a letter requesting a tanker. They can get different size tankers at different frequencies depending on how many residents sign the letter. 'A 1000 litre tanker should supply 10 houses - if there are more houses more tankers are required from the DJB. This is not exactly a *niyam* [rule or policy] but like a rule of thumb'[169]. The letter must be taken to the MLA's office to be stamped or signed before it can be passed on to the DJB.

Once ordered, 'the DJB tankers do not always come. They take the water and sell it to someone else they have a setting or acquaintance [*jaan-pehchaan*] with'[170]. Residents have said that a connection with the MLA or DJB is needed to get tankers to arrive[171]. People feel that without a connection, the treated DJB water is sold off to wealthy private buyers who

[168] Personal communication, local residents, NGO office, Sangam Vihar, 16/02/14, fn21
[169] Personal communication, party worker, Sangam Vihar, 9/07/15, fn93
[170] Personal communication, NGO manager, Sangam Vihar, 17/06/15, fn87;
[171] Personal communication, local residents, NGO office, Sangam Vihar, 16/02/14, fn21; (Sheik, Banda, et al., 2015, p. 5); 'settings' required for DJB tankers in Sangam Vihar also reported in (Halder, 2017a)

have an understanding with the driver or DJB office and that, if it arrives at all, the tanker will be refilled with untreated water from a tubewell.

> 'Deoli and the neighbouring Ambedkar Nagar and Sangam Vihar constituencies are largely made of unauthorised colonies which have no access to piped water. The DJB provides tankers which, the residents claim, are scant and unreliable.
> "Very often the DJB officials say they have lost the cards that allow them to take water from filling points or that the tanker has a puncture. They find any excuse not to deliver water to the people who need it as they then sell it for double the rate in the market," alleged Mr. Prakash.
> While raising slogans, the residents said they were being neglected as they were economically weak. "The driver who was beaten in Sangam Vihar was actually selling the water for ₹2,000. Seven tankers leave from here with our names on it, but only one or two reach," said another Tigri resident Ravi.
> The protesters blamed collusion between the DJB officials and the private tanker mafia for the problem.
> "They leave us with no option so we have to buy from the private tankers. It is basically extortion," added Ravi.'
> (The Hindu, 2014)

One of the Sangam Vihar MLAs has two offices in the constituency, a public office where he himself sits three days a week, and a 'back office' with no sign on the street where his staff hang out and complaints about tankers and other issues can be handled. In talking with party workers from four constituencies across south Delhi, it became apparent that there is an unwritten division of responsibilities for tanker service between the MLAs and the DJB. In Chhattarpur and the Sangam Vihar Constituencies this means that the MLA's staff have responsibility for emergency tankers while DJB staff retain control of the 'point' tankers, which are supposed to visit specific places on a set schedule. In some areas it was seen to be one of the perks of an MLA seat that there would be a certain number of water tankers (I was quoted 40) under the MLAs direct control which could be disposed of as desired - either for private sale, or to favoured constituents.

The MLAs offices have regular interaction with the DJB over water tankers, which is an indication of tankers' importance and unreliability. During my research period, I met Ritesh, who were was working full time for one of Sangam Vihar's MLAs to record complaints over tankers that have not arrived and to make enquiries with the drivers and the DJB. 'The main argument from drivers and the DJB', Ritesh tells me, 'is that the tanker has broken down

and cannot reach the delivery point'. 'If there are five tankers allocated daily, this can happen once-or-twice a day. We have caught them, knowing they have sold the tanker in black but the DJB protects the drivers'[172]. As the drivers do not inform Ritesh if they have broken-down part of his job is to send people to check if the tankers have really broken down or if they are 'just pranking'. Ritesh described some of the challenges of this role:

> 'My name is blacklisted in DJB and private tankers fear of my name because of my putting their earning down. I have been offered money, wine, many things. I refuse. I finish three years in this party for corruption-free India and this party […] They are offering everything. In my personal opinion corruption is in those things which have 'settings' [illicit arrangements / understandings]. *Dalals* [brokers / dealers / pimps] were doing setting in *bigha* [a unit of land], now is 'setting' of water. When we will not have things like this, so automatically the share of these pimps will shrink. I will do everything if I need water, even I don't have for drinking. If home has water then automatically I will pay you. The DJB officials don't know'. Personal communication, party worker, Sangam Vihar, 18/05/2015, Hindi and English, fn81

To monitor tanker arrivals, the AAP party in the constituency has a network of lookouts in different streets, usually young boys, whose responsibility it is to report if tankers have arrived[173]. Tankers often fail to arrive, and everyday people come to the office to complain about this.

> Two other women come in - they are allowed to come into the inner office. They seem more friendly, more confident and are smiling a little bit. They say that their tanker hasn't arrived. Ritesh is busy looking at his phone and takes a long time to acknowledge them. They are berating him but he says "Look, what can we do? Ok, I'll give you a number". He writes a number on a slip of paper and gives it to them: "This is our boy in your lane, go and talk to him about it". The women say "Ok, we'll call him but if we have a problem we'll come back to you". Ritesh looks resigned. I ask him about it and he says that they have a boy in the lane who is watching out for tankers…
>
> He also promises a number to the smart looking man, wearing a shirt and glasses, who comes in later. The man says "we have asked for a tanker but it hasn't come and they just say "we'll send, we'll send". Ritesh asks the man to sit outside. He is still sitting outside when I leave about half an hour later. It seems that there are party volunteers working for Ritesh spread out over Sangam Vihar to check whether tankers have arrived or not.

[172] Personal communication, party worker, Sangam Vihar, 18/05/15, fn81
[173] 'Young male children […] scour the camp for news and updates about water' (Datta, 2012, p. 137)

> Observations, MLA office, Sangam Vihar 18 June 2015, Hindi, fn88

Since the AAP government came to power, drivers have been fined for not arriving. Ritesh explained the costs to me. Tankers get paid ₹1,000 per day for five trips. This ₹900-1000 a day would go to the owner and he would pay the drivers salary from it. So in a month, the tanker owners could receive ₹30,000, of which ₹8,000 to ₹10,000 would go to the drivers, and ₹20,000 the owners could keep. I asked about the 'tanker companies':

> There are not companies - tankers are [owned by] private individuals. If you have money you can buy a tanker and rent it out to the DJB. If the tanker is not delivered on time they will charge ₹5,000 for one missing trip. If two trips in one day are missed you will have to pay 10k. It's to create fear. But everybody is shaking hands – the DJB, tanker owners and drivers. This is my personal view. This is the main problem. The owners make money and give the DJB a cut.
> Personal communication, party worker, Sangam Vihar, 18/05/15, fn81

In Chhattarpur I met Asad, who was a member of the MLAs office, seconded to the tanker filling station with responsibility for 'emergency tankers'. Similar to Ritesh, he seemed to have some difficulty in controlling all deliveries. Asad was often shouting instructions to the drivers and telling them to be sure to go to the right person. There was a problem where a driver seemed to have not delivered to the right place, and Asad was checking his sheet. The driver was saying 'look it's signed', while Asad looked unhappy but unable to do anything[174]. Observations from the AAP office in Sangam Vihar also suggest that there are challenges in addressing tanker (and tubewell) capture.

> A large group of women has come to the office to complain. They exchange greetings with Ritesh. A girl with glasses says "We need water" and gives him a neatly hand written letter in Hindi signed on the back by a list of names. Two girls, maybe 16 and 18, are acting as the main speakers, and about seven older women, who are also not afraid to chip in. They want a regular water tanker as they are not getting water from the local tubewell. It is not coming and when it is someone else is taking it. They say that the water is captured by the powerful people - both from the tubewell and the tankers. Someone who lives near a Beauty Parlour – Ritesh knows who they mean. […] When I ask them how they have been getting water they say "fighting - with the people that are capturing it". They also say that they are having to go to other places and bring water back in buckets. […] Afterwards in the inner office there is a loud discussion among the volunteers about this

[174] Observations at Chhattarpur Booster Pumping / Tanker Filling Station, 14/05/15, fn72

> situation. Ritesh is saying we should do something, but Prakhar is saying "No, you don't know who those Beauty Parlour people are".
> (Observations, MLA office, Sangam Vihar, 18/05/15, Hindi, fn82)

Public tanker supply is valued over more expensive alternatives, in so far as it is low cost or free[175], although it also imposes household costs in terms of waiting and uncertainty[176]. Private tanker supply is valued for greater reliability although it comes at a substantial cost[177]. Typically, a street will club together to pay the fees and then each household will fill its storage tanks. A whole tanker of four thousand litres costs from eight hundred to two thousand rupees, depending on the supplier, client and time of year[178]. The many parked tankers at main road point to the presence of tanker operators in the area. However, the tanker owners and staff around main road that I spoke to were on the whole not keen to talk once I disclosed that I was not a potential customer but was doing research. These tanker owners were usually placed within another nearby business, such as construction materials, mechanical repairs or real estate, although some operated from residential premises. The drivers, generally say it is easy work, although sometimes in summers it is so busy that they work two shifts, with one sleeping while the other drives. A full tanker of water sells for around ₹800-1,500 depending on the area and the time of year, as business goes quiet in the winter. Sometimes take water from the river or nearby, sometimes from industrial areas in Haryana, Badarpur, Meethapur[179] (where it is well known that the water table is higher and there are many water bottling factories), sometimes from tubewells (DJB

[175] Personal communication, former private sector water supplier, 22 April 2015, fn57; Observation and discussion at Savda Ghedra Water ATM plant with Development Alternatives, November 2014
[176] Personal communication, Renu Khosla, NGO Manager, Hauz Khas, 21/10/14, fn134
[177] Personal communication, local residents, Sangam Vihar, 16/02/15, fn21; Personal communication, resident, 17/06/15, fn87; Personal communication, local residents, Sangam Vihar, 16/02/15, fn24; Personal communication, local party worker, Sangam Vihar, 9/07/15, fn93
[178] Personal communication, private tubewell owners, Sangam Vihar, 04/02/15 fn16b; Personal communication, local residents, Sangam Vihar, 16/02/15, fn24; Personal communication, tanker driver, 16/11/15, fn119; Personal communication, AAP party workers, Sangam Vihar, 18/05/15, Hindi and English, fn81; Personal communication, resident (female, c.30), BJP supporter, 17/06/15, fn87; Personal communication, local party volunteer, Sangam Vihar, 9/07/15, Hindi, fn93; Personal communication, tanker owner, Sangam Vihar resident, Saket, 16/08/15, Hindi, fn115
[179] Personal communication, jar delivery driver, Bandh Road, 16/02/15, fn20; Personal communication, real estate dealers, Ratiya Marg, Sangam Vihar, 6 February 2015, fn17; Personal communication, NGO manager, Sangam Vihar, 16/01/15, fn13

and private), sometimes from DJB filling stations, sometimes from rural farmers. Both DJB and private tankers have a target of five trips per day[180].

Unlike reports from other research, in Sangam Vihar, there is competition between private tankers and they do not have set territories (cf Borthakur, 2015; Kjellén & McGranahan, 2006; Rai, 2012; Ranganathan, 2014) (F16, 115). Private tankers fill from both private and public tubewells within Sangam Vihar, as well as outside (F115). As Aasha explained to me:

> 'There is not [enough] water in the [tubewell] pipes but the private tankers are selling it[181]. They take it and sell it anywhere. The people then have to buy private tankers or cans or boil water. You remember Shiv at Masjid Mohalla? There is water in his borewell but he does not give it to the people in the lane at Masjid Mohalla: it is for his people only. […] So there is no water in the pipes for the people paying 100 rupees. At this time there is no water, it is difficult.'
> (Personal communication, resident (female, c.30), BJP supporter, 17/06/15, fn87)

Aasha went on to say that the tanker owned by Viraj, the area p*radhan*, and managed by a friend of hers, Gopal, fills from a tubewell captured by the *pradhan*, and has a target of five tanker trips a day. I have never heard private tanker staff describe a daily target to me, but DJB tankers do have a target of five trips a day (F81). The suspicion is that the tanker has been subcontracted to the DJB, is using tubewell water for official (nominally free) deliveries and selling the treated DJB water to higher paying customers. Tubewells and tankers, public and private, bleed into one another in *fluid* combinations (Mol & Law, 1994).

As mentioned above, conversations with tanker owners suggest that there is lively competition in the water market. I was at Aasha's place when I first met Shiv, the area *pradhan* (see page 158). He seemed sharp, business-like and a bit reserved, but knew Aasha well enough to hang out and chat for a bit, even after conversation had dried up. I didn't know he also sold water as a *kholnewala*, and asked him about tankers. He said tankers were run by "criminal types" [using the English] and "*badmash*" [troublemakers /rogues]. I asked if the tanker owners talked to each other and were organised but he said 'They are all

[180] Personal communication, senior party worker, 18/05/15, fn81; Personal communication, local resident, Sangam Vihar, 16/01/15, fn13.
[181] Also reported in (Sheik, Banda, et al., 2015, p. 5)

separate. There are lots of different companies' working in overlapping areas[182]. Other interviewees also made this observation, including Bibek, tanker owner and (BJP-aligned) activist.

> Bibek: There are 30-40 tanker businesses in Sangam Vihar, maybe over one hundred tankers. The tanker business people know each other.
>
> Researcher: Do you talk to each other?
>
> Bibek: We talk to everyone! Competition is there but it is driven by demand not a desire to compete with each other. In winter season demand goes down, so prices will also go down, so competition is there.
> (Personal communication, Sangam Vihar tanker owner, 16/08/15, Hindi, fn115)

The tanker owners I have spoken to in Sangam Vihar have tended to run small businesses of between one and five tankers[183]. Even a small one tanker business running four-five trips a day could turn over ₹60,000 a month at a conservative estimate. Owners however claim that after paying for the water (₹100 per tanker in rural Haryana), petrol and salaries they make much less. I was quoted ₹100 per trip as net profit - more like ₹12,000 a month for a one tanker business. I met Bibek on Independence Day at a fancy mall. He offered to come to meet me, which was unusual. He said he had interests in several other businesses including property and a small NGO. Bibek had just one 4,000 litre tanker, which he fills from a farmer's tubewell in Haryana. He pays the farmer ₹200, it costs about 200₹ for gas, and about ₹200 for staff. A tanker of water costs about ₹800-1,000 to buy. So he doesn't make that much money from it, he implied. Tankers themselves cost around four to five hundred thousand rupees, as do the tractors used to pull them. This cost structure is very similar, although slightly higher, to that found in research ten years earlier (Das Gupta & Puri, 2005). In Sangam Vihar it seems that most tankers fill from someone else's tubewell or captured tubewells; this is unlike the situation in Bangalore described by Borthakur where tanker businesses also owned tubewells (Borthakur, 2015).

[182] Personal communication, *pradhan*, Sangam Vihar, 6/11/14, Hindi, fn11
[183] For two interviews with larger and more profitable tanker business owners in Bangalore see (Borthakur, 2015, pp. 25–26)

Bibek has two people that work for him on the tankers. When an order comes they go and get the water. He says he runs tankers 'as social service, not to profit from others problems'[184]. A tanker owner interviewed by Malini Ranganathan in Bengaluru also 'identified himself as a social activist' (Ranganathan, 2014a, p. 90). Bibek showed me photographs on his phone of *dharnas* he had organised over lack of water to Sangam Vihar. When I went to visit 'his NGO', Bibek actually took me to his friend's real estate office. A subsequent internet search revealed that Bibek has links to the local branch of the BJP.

Because tanker owners are also in other businesses like security or auto-rickshaws or real estate, they are not concerned about government moves to shut down illegal bores and bring piped water – we have other businesses they say. Bibek, had shown me photographs of his *dharna* demanding piped water for Sangam Vihar, and told me that: 'I know that business not a long-term thing. No problem - it will be a good thing when piped water comes'[185]. Similarly, when I asked Tej, the AAP activist what the tanker owners will do when the Sonia Vihar water comes and they can't make from tankers anymore (above p97-98), he said simply, that they 'will sell milk or property'[186].

[184] Personal communication, tanker owner, 16/08/15, Hindi, fn115
[185] Personal communication, tanker owner, 16/08/15, Hindi, fn115
[186] Personal communication, resident and AAP party worker, Sangam Vihar, 9/07/15, fn93

30,000 litre private water tanker delivers to an expensive shopping mall in South Delhi

There is also a high-end of the tanker market, which supplies to expensive hotels and shopping malls (see following Chapter). I contacted these larger companies many times, but their representatives declined to talk to me. The large, expensive malls outside one urban village I lived in received regular deliveries from 30,000 litre tankers. One night I witnessed 12 deliver back-to-back in the space of an hour. They supply every night and during the day the company's tankers are parked behind the mall. The drivers, who are usually from out of state, say the water is from Haryana, which is a Central Ground Water Board 'black spot' hence extraction there is illegal. A journalist working on Delhi's water mafia expressed it to me this way: 'they would not be able to bring it from anywhere legal without their transport costs becoming prohibitive'[187]. The high visibility of large tanker deliveries to wealthy commercial properties contributes to a feeling among lower-income residents that the rich are well serviced by both the public and private sector, while other groups are neglected[188].

Tankers illustrate the fluid nature of the formal/informal divide – the location of a tanker may be all that determines its legality or illegality. A private tanker may carry DJB water, a

[187] Personal communication, Aman Sethi, 2/06/15, fn86
[188] Personal communication, resident and AAP party worker, Chirag Delhi, December 2015, fn35

DJB tanker may carry water from a private well, a DJB tanker may carry DJB water to an unauthorised client and private tankers may carry water from private wells (illegal if water comes from Delhi state or other critical groundwater zone, also if water is sold for human consumption without requisite certifications). This variation and complexity highlights the importance of specificity when discussing 'urban informality' in the abstract. Just within water, it should be apparent from my empirical work just how different informalities in piped supply, tanker provision and tubewell management are. The differential quantities of water supply observed in Chapter Four are further differentiated by the different qualities of specific modes of supply. Consequently, any general theory of 'urban informality' as a 'mode' is likely to be very thinly stretched and over-generalised.

BOTTLES, 'CANS' AND ILLEGAL FACTORIES

DJB piped water supply quality differs in different neighbourhoods (see Appendix WQ, page 288) and in some areas of the city people are content to drink directly from the tap. However, in Sangam Vihar, people who absolutely cannot afford anything else will use bore or tanker water for drinking, boiling it before drinking. Households with more income will use reverse osmosis (RO) filters, however the prices for these start at around ₹3,000 so are too expensive for most people. Shops that that sell RO filters in Sangam Vihar say they do not sell more than one or two a month. In between these two extremes most people in the area, as well as Malviya Nagar and many other areas of Delhi, drink 'bottled water' supplied by small private companies in large plastic 20 litre 'water-cooler' jars. The water cans are similarly priced across the city, and cost from rs100 for branded water like Bisleri[189] to ₹20-40 for 'local' produced water sold in Sangam Vihar (and ₹10 futher east[190]). This private drinking water supply is trusted to be cleaner to drink than any other available options, which have a high chance of containing bacterial pollutants[191].

> The piped water is not for drinking. People use ₹20 'bisleri' cans, about one per house per day. These local cans are borewell water put through an RO. The (branded) Bisleri ones are too costly, so they take the cheap (₹20) ones.

[189] Personal communication, resident (male, c.28), Greater Kailash, 11/07/15, fn145
[190] Personal communication, Lucy Dubochet, 20/01/17
[191] Personal communication, Khirki resident, 7/08/15, fn109; personal experience

> (Personal communication, local party volunteer, Sangam Vihar, 9/07/15, Hindi, fn93)

Large households might use two or three jars a day in the summer[192]. This costs over ₹2,000 a month. Even migrant workers, recycling plastic waste and rags and living in crowded tarpaulin shacks, buy drinking water in these plastic cans. Sanjay and I sat with these workers outside one of their tents. They were from West Bengal, Muslims and Christians. They told us that their boss [*thekedar*] sent a tanker of water for them once a week but they only use the water in the tanker for bathing and washing clothes. The tanker costs ₹300 per person per month which their boss deducts from their wages. They told us that if they drink the tanker water they get sick and have strong pain [*mota dard*]. So for drinking they buy the 20 litres jars for ₹20 a jar. They use one per day for a family of four or five people. Adults get paid around 1,000 rupees per month, children less. They pay ₹600 per month for drinking water and ₹300 for household water on a household income of 5,000 rupees. This is slightly under twenty percent[193]. Similarly, in another large low-income area of Delhi further east, all but the very poorest purchased drinking water from illegal factories, either in these 20 litre jars or in buckets from the factory itself[194]. Again, in a higher-income area further west (Dwarka):

> In my area there was no water earlier so we used to call tankers from the DJB but it was not for drinking - people are still relying on bottled water. Nowadays people don't call tankers. Some people rely on DJB [tankers] but most don't drink DJB. Bottle water is now used instead of tankers. 1 year ago till few months back Dwarka was bone dry, no nothing. 1k litres RS4-500 but 90% of people would never use tankers for drinking purposes. In Dwarka a lot of private tubewells are dug - by influential people and no one says anything. New private tube wells are illegal but if it happens money is given to police.
> (Personal communication, Dwarka resident, Saket, 16/08/15, fn115)

Alankar, in his PhD thesis notes the rise of 'flourishing business involving private suppliers selling bottled water in different quality containers (in majority of cases 20 litre plastic jars)'. He states the need for information on 'on how the private suppliers get to procure such huge amounts of water' (Alankar, 2009, p. 111). While Alankar suggests that bottle water

[192] Personal communications and focus group discussion, Sangam Vihar, 16/02/15, fn24
[193] Personal communications, recycling workers camp, Sangam Vihar, 2/05/15, Hindi, fn63.
[194] Personal communication, Lucy Dubochet, London, 17/01/17, fn137

comes from 'DJB sources', in my research, answers to the question of where 'bottled' water comes from varied, however it was very often groundwater. A local *pradhan* in an area where cans are commonly used said the water comes from the edges of, or outside of, Delhi state.

> "The canned bottles of mineral water are for drinking. They come from outside from Badarpur or outside Delhi". "Haryana", Bhalli is keen to point out. "Shops distribute them door to door. The can distributers are separate from the tubewell people there is no overlap".
> Personal communication, *pradhan*, Sangam Vihar, 03/07/15, Hindi, fn91

Not all bottled water comes from across the border; sometimes, if not the same neighbourhood, it is from the next one over. Sainik Farms, adjacent to Sangam Vihar, is a wealthy neighbourhood of 'farmhouses' (luxury villas constructed on agricultural land). Like Sangam Vihar, it was also constructed without planning permission and is dependent on groundwater. However, unlike Sangam Vihar, residents are able to install personal tubewells. I met a truck driver delivering 20 litre cans of water to the Deoli side of Sangam Vihar who told me that the water was from Sainik Farms[195]. Other interviewees confirmed that this was part of a broader pattern.

> "Sainik Farms is a different model. People have bores in their homes and sell or rent the water."
> Personal communication, real estate dealer, Sangam Vihar, 06/02/15, Hindi, fn17

The following note from a conversation with a water dealer in another peri-urban area of Delhi gives some more information about the production of canned water:

> [I sell about] 50 [20 litre] cans a day. Proper original Bisleri [a bottled water brand] is ₹70 per can. Local is ₹30. It doesn't come from a factory just someone with a tubewell and an RO [reverse osmosis filter] who fills up cans. Nothing special is needed to do this work. The branded labelled cans come from factories. It's illegal but the police and [water guys], PWB [Public Works Board], MCD [etc] can be given money and they will turn a blind eye. The amount depends on the settings [relationships, understandings] it might be ₹500 a week or month for the cops, ₹2,000 for the DJB.
> Personal communication, water seller, Kapasevra, 22/01/15, Hindi, fn89

[195] Transect walk with local resident, Sangam Vihar, 6/11/14, fn11

Private water treatment plant (left), canned water delivery worker (right)

In more central areas, water factories are low key, small-scale affairs. A contact in Sangam Vihar who is a partner, with the area pradhan, in a tanker business which gets water from a *gali* tubewell, also has an RO plant on the top floor of an under construction building in a nearby unauthorised colony. He says that his business that uses the RO plant has four tankers and six employees on bicycle carts who take can to shops. This business generates around rs30,000 per month, however like other tanker owners I've spoken with in Sangam Vihar, the water business is a supplementary source of income and his main business, which his father also does, is real estate. Khirki Extension's local water brand 'Delhi Gold' is located in the extension. Their bottles provide an email address and phone number. The phone number on their bottles connects the caller to Delhi Police Control Room. They are said to be linked to a local official, who has a track record of complaints against her[196]. Prosecution of an official in the same position at Malviyar Nagar for demanding money to allow bore well operation is reported three years previously (Seghal, 2012; The Hindu, 2004; Zee News, 2004).

The drinking water business seems to be a fairly safe investment destination and generator of employment in underserved areas. Those that I visited were almost always staffed by a crew of young men. During my fieldwork period, one of the young men working at the NGO

[196] Personal communication, local resident and RTI activist, urban village (Hindu/dalit), south Delhi, 21/01/15, fn14

helping with my fieldwork gave up volunteering to work in a water business with his brother. This was helped by connections to the other water sellers operating around the NGO. I could only interview one factory owner inside my research sites but I am aware of three other informal factories. More, and larger, drinking water factories are situated further south east and east towards Okhla, Badarpur, Noida and Ghaziabad – the more corporate branded drinking water cans have addresses on their labels, which I check at every opportunity![197] The water table is higher in these areas, and there are large industrial areas. A researcher working in the Okhla area reports 27 illegal bottling plants in her field site[198].

Technically abstraction of groundwater for commercial purpose is illegal under the Delhi Jal Board Act (1987). The Central Groundwater Board's recently released Guidelines on Groundwater Abstraction clearly state that abstraction for industrial / commercial use in over-exploited areas is not permitted. Although reluctant at first to discuss it, a senior Delhi Jal Board officer I spoke to was insistent that this bottled water or 'canned' water is groundwater. On the question of whether this is legal or illegal he said "let's not go into that". Later in the conversation he does discuss the legality, partly as a way of avoiding my question about the quality of groundwater supplied by the DJB to unconnected areas.

> "Groundwater extraction is possible if the government is failing to supply. Groundwater is still governed by the Indian Easements Act of 1892, a British Era law, which states that groundwater is the property of the landowner. So for the government to regulate groundwater would be to deprive the landowner of their property. It actually becomes a legal nicety depending on whether the landowner / government can prove failure to supply or not."
> Personal communication, Chief Engineer Planning, DJB offices, Jhandewalan, Delhi, 10/04/15, fn51)

[197] Factory locations also mentioned in Personal communication, NGO manager, 16/01/15, fn13; Personal communication, real estate dealers on Ratiya Marg, 0602/15, fn17; Personal communication, bottle delivery driver, Bandh Road, 16/02/15, fn20; Personal communication, *pradhan* and *kholnewala*, Sangam Vihar, 3/07/15, fn91; Personal communication, tanker owner and real estate dealers, Bandh Road, Sangam Vihar, 18/08/15, fn135

[198] Personal communication, Lucy Dubochet, London, 17/01/17, fn137

CONCLUSIONS

Previous researchers emphasise the importance of disaggregation of 'water supply' in the abstract (Ahlers et al., 2014; Marie-Hélène Zérah, 2000a). Studies of public network water have also emphasised the importance of materiality (Björkman, 2015) and called for greater attention to the 'the manner in which the peculiar materialities of technologies matter' (N. Anand, 2017, p. 11). The different supply modes I describe also present different possibilities for politics, patronage, rent-seeking and capture. Different modes have different topologies and temporalities – network, region, intermittent, fluid (Mol & Law, 1994) – and consequently different visibilities.

While public and private tubewell networks (and we have seen the distinction between them is often ambiguous in practice) operate over an exclusive territory defined by the infrastructure, private tanker supply appears to work much like any other grey-market business (cf Ranganathan, Anand, Graham et al). The suggestions of a nexus involving overlapping interest groups of party workers, politicians, caste representatives, real estate brokers and investors, private sector water suppliers, and water board workers intimates that the distinction between public and private actors for the water system as a whole may be misleading. Control over, even investment in, water and land are related and there are indications that both are managed by historically dominant local (caste) groups, at the expense of newer residents. Water, land and politics are closely related spheres of informal influence, however their dynamics differ to each other in ways that caution us against using 'informality' in the abstract (cf McFarlane and Waibel).

In relation to water and India's 'porous' state, the work of Anand, Björkman, Contractor and Jha et al echo my findings of the role of discretion, patronage and political representation (N. Anand, 2011, 2012; Bawa, 2011; Björkman, 2015; Contractor, 2012; Jha et al., 2007). However, the impact of groundwater on the nexus of informal water, land use and politics is not extensively studied (Desai & Sanghvi, 2017; Kacker & Joshi, 2016). In one of the few papers explicitly discussing tubewell networks in Sangam Vihar, Kacker and Joshi characterise the tubewell networks as being initially captured DJB bores or private networks and being replaced by RWA managed networks with MLA support. Kacker and Johshi spoke

to RWA members in B and D blocks, at the northern edge of Sangam Vihar nearest the city. My interviews were with residents from eight blocks, primarily those at the less-developed fringes of Sangam Vihar. To reiterate the point about variation and specificity, it appears that the situation is different across blocks. Further, I show that both formations continue in parallel. This indicates that initiatives to 'reform' or 'renationalise' private tubewell supply in Sangam Vihar have previously been attempted, and failed, under BJP MLAs and Congress state assembly (Kacker & Joshi, 2016, pp. 263–267). Rather than see the tubewell supply in Sangam Vihar as 'illegal' operations filling 'the gaps in public services', my findings seem to suggest that they negotiate the porous edges of the local state in this context (Kacker & Joshi, 2016). Instead of proposing a trajectory of civil society mobilisation and formalisation of small-scale local providers in an example of the co-production of urban services, my research suggests that local civil society groups, informal enterprises, and political representation are problematic and resilient in the face of disruption. This view is more in line with Malini Ranganathan's argument about water tanker businesses in Bengaluru, that they 'strategically blur the boundaries between state and society' (Ranganathan, 2014a, p. 91).

A similar situation to the borewell capture that I describe, is municipal tap capture by criminal groups described in work on Mumbai (Bapat & Agarwal, 2003, p. 82; Weinstein, 2008, p. 26). Tap capture by local groups, along caste or communal lines, is also described in Patna (Rodgers & Satija, 2012, p. 4). The connection I find between water tankers and tubewells is also, cursorily mentioned by Graham et al in work on Mumbai: 'private water tankers also obtained water from bore wells, pointing to profits being made through excessive and often unregulated groundwater extraction' (Graham et al., 2013, p. 135).

Other work on water tankers has suggested that they operate as a cartel with a spatial monopoly (Borthakur, 2015; Kjellén & McGranahan, 2006; Ranganathan, 2014a) and 'state-like' public authority (Ranganathan, 2014a). However, in my research this has not been the case, and tanker firms operate as informal private businesses. Tubewells, however, do have spatial monopoly and are 'state-like', connected to locally powerful groups, patronage and rent-seeking for election expenses by political parties. The dynamics of these forms of water supply are strongly influenced by their respective (technical and ecological)

materialities; tankers are mobile and intermittently present across a network of points, tubewell networks continuously occupy territories (albeit with fluid and sometimes overlapping edges) remote from state agencies.

The availability of ground water as a supplementary external input dilutes public anger at partial government supply. As groundwater provision through tubewells and tankers allows greater discretion for local politicians, it offers the possibility to affirm relationships with local constituents as well as to accrue financial gain for personal and party funds. However, at the same time, water, in this case groundwater, 'exceeds politics and destabilizes its distribution regimes' (N. Anand, 2011). The 'vote bank politics' that leaves the populations of unauthorised colonies reliant on ad hoc interventions from politicians for urban services and decreasing amounts and qualities of groundwater, has led to an electoral backlash. The AAP campaign, promising to end this type of politics, was helped by the water situation (groundwater decline and price rise).

The government supply through tubewells and tankers in Sangam Vihar magnifies the unevenness present in official network water supply. The provision of off-grid and decentralised infrastructures like tubewells and tankers in place of a network connection allows for greater discretion by agency and political workers and appears more porous to external influence, patronage and capture than is possible with piped network supply. Small private sector water suppliers operate as unregulated for-profit businesses with sub-optimal (higher cost, less reliable) outcomes for consumers. These combinations lead to water governance formations which are highly varied and localised down to street or household level. While some areas benefit from low cost water at convenient times, most often outcomes are sub-optimal, and households must spend a high proportion of their income on securing potable water from the private sector. This leaves water users feeling disenfranchised and exploited but with little recourse for complaints. It should be noted that water provision appears to be seen as a female responsibility, and the vast majority of 'water users' I spoke to at a street level were female. Visitors to the MLA offices with complaints of inadequate supply were both male and female. With the exceptions of one *kholenewali* and one *pradhan*, tubewell managers, local politicians and MLA staff were entirely male.

The decentralised informal infrastructures in this chapter are less visible and more socially embedded than piped network supply. The 'informal political economies' of water supply here, within and outside state provision, appear to be linked to city politics and embedded in local economies of caste, land and real estate where powerful actors have some degree of state and/or social power. This makes them harder to reform towards greater transparency, accountability, or equity. This also brings unregulated environmental consequences in the form of unchecked, unmonitored groundwater depletion, and pollution as a result of discharge from treatment facilities. These decentralised modes, because they are more localised and susceptible to local control, are also hard to reform, for the AAP and others. The DJB is unable to use their own men as *kholnewalas* in Sangam Vihar unlike other areas (cf Ghertner, 2017). This informality, is not generated by state power, as Roy suggests, but by state weakness. AAP reforms in Sangam Vihar appear to have underestimated the extent and resilience of local control over non-network sources, which has led to the AAP's longer term strategy of removing non-network sources as far as possible.

There are important connections between these different informalities. Informal tenure leads to denial of services, which in turn leads to informal provision secured through informal intercession and politics. Control over land has led to influence over politics and water for the locally dominant caste and the exploitation of migrant settlers. Ranganathan also highlights the links between informal water and informal land development (Ranganathan, 2014a, p. 91). In work on water in other cities, religious discrimination is observed (N. Anand, 2012; Contractor, 2012), but caste is not mentioned. Researchers have also found that conversely, knowledge and control of water has allowed individuals to move into politics (Björkman, 2015; Contractor, 2012) and control over land (Cooper, 2011). However, while informalities in land, residential status, employment arrangements, state access, political patronage, and urban services are related, *they are not the same*. These cases, then, complicate thinking with a general theory of 'urban informality' drawn from empirical research on land or labour (AlSayyad, 2004; Benjamin, 2004; Kudva, 2009; Roy, 2005), and suggests the difficulties of thinking across infrastructure modes (Marie-Hélène Zérah, 2008). Informal land settlement can allow the establishment of economically

productive neighbourhoods by providing lower-cost, more flexible, better located, residential, industrial, commercial and community spaces than would otherwise be available to low-income people (Benjamin, 2004). For example, while informal land use may support mixed-use clusters with benefits for low-income residents, informal water use appears to primarily be of benefit in allowing the formal network to save the costs of expansion, local representatives to trade piecemeal improvements for political loyalty and local entrepreneurs to generate income and a small amount of informal low-skill employment. Informal water supply then appears less beneficial and is primarily valued in the absence of any alternative.

In the next chapter I add an additional layer of complexity to this picture of water governance arrangements in South Delhi; reforms under a Public-Private-Partnership for commercial water management. This project has to negotiate not only the vagaries of government water described in Chapter Four, but also the informal systems described in this chapter. Although less extensive in the Project zone, private networks, tubewell capture and unauthorised connections to the government network are very much present. As well as responding to these informalities and the politics of water that they lead to, the Project also generates its own forms of informality and politics. The complex interactions this gives rise to are the subject of our next chapter.

CHAPTER 6. PUBLIC PRIVATE PARTNERSHIP: MODELS AND MUD

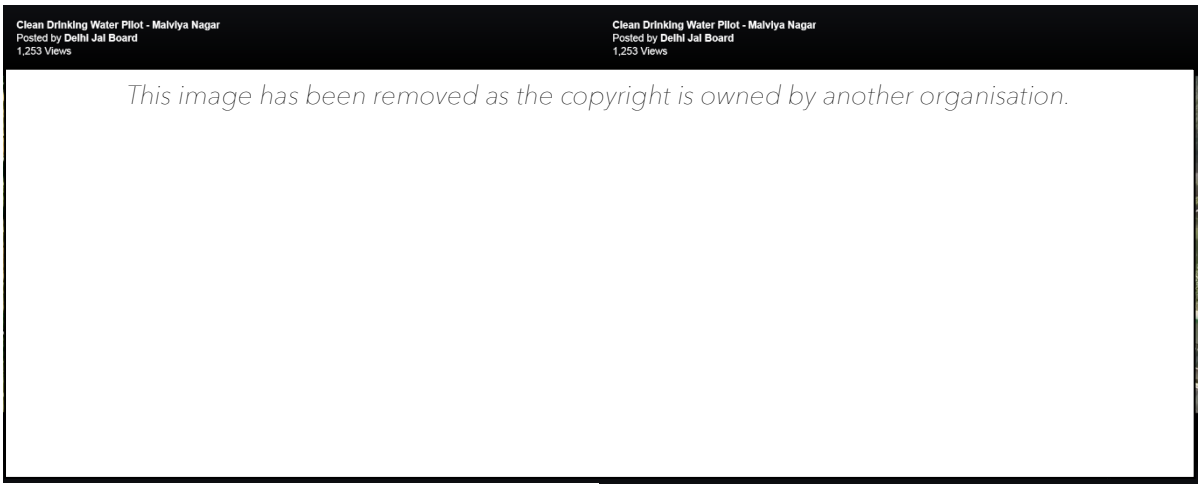
In this chapter I address the third research question '*What are the relationships between informality, groundwater and water governance reform initiatives?*' To do this I describe the progress of a Public Private Partnership (PPP) for urban water supply in Delhi. This builds on my analysis of informality and groundwater use in previous chapters and introduces the PPP Project as an additional layer of urban water governance.

The transfer of water network management to a private operator under a PPP contract provides a unique diagnostic event through which to investigate the social and political dynamics around water supply and access arrangements in South Delhi. At a policy level, private sector involvement is heavily promoted by Central Government, multilateral and bilateral agencies as a means to leverage finance, expertise and technology for urban infrastructure and services in Indian cities. My discussion of a project in a complex and dynamic area of Delhi, 'the most favoured city', provides a limit case of what should be highly favourable conditions for private sector involvement (Sivaramakrishnan, 2011). After examining the project aims, rationale, location and environment, I will consider two main aspects: a pilot initiative for 24-hour continuous water supply in a wealthy neighbourhood, and network rehabilitation in unplanned areas.

This chapter illustrates the complexity of the physical and governance environment that urban PPPs for water distribution must engage with in India. I make several points. The first concerns the interplay between international agencies and local actors in influence over Delhi's water supply arrangements and policy. In this case, unlike the standard narrative of powerful international organisations exploiting the local public sector, the Multinational partner ('the Multinational') in the PPP project ('the Project') appears to have been insufficiently diligent to the advantage of the Delhi government. The tendering outcome also appears to have favoured the 'Local Partner' infrastructure company involved in the joint venture. The Project has innovative features in scope, connection targets and tariffs,

which mark an evolution in approach from earlier generations of privatisation initiatives; however, the existing levels of physical and administrative informality in water supply have meant that the joint venture ('the Operator') has found it difficult to understand and map the water supply network they are managing. As in previous chapters, power and influence structure relationships to infrastructure; however these elements of the Project context are outside the scope of the Operator's expertise. While the Project was heavily oriented towards demonstrating 24/7 continuous water supply, this was not necessarily cost-effective or appreciated by consumers. As described in the previous chapter, groundwater is used as an external supplement to support the formal network. The role of personal intercession, heavily informalised physical and administrative systems, and uneven provision of services across areas and by class, caste and religion should also be apparent. My research suggests that despite enthusiasm to learn how to work in this environment, these complexities and challenges are still underestimated by corporate actors.

The Chapter is structured in three parts: an outline of the history and evolution of the privatisation project in Malviya Nagar; a discussion of the 24/7 continuous supply initiative in a wealthy neighbourhood; an outline of the progress of the Project in unplanned, low-income neighbourhoods; and a discussion of communication and public relations challenges.



PPP promotional video stills of location and site offices

PRIVATISATION IN MALVIYA NAGAR

"…here we have more surprises than anywhere…"
Personal communication, Project Manager, Malviya Nagar, 21 April 2015, fieldnote 56

The commercialisation of the Delhi's water has been under consideration since the Delhi Jal Board (DJB) was constituted in 1998 (Government of National Capital Territory of Delhi, 1998 - see *Chapter Four*). In 2002 the DJB commissioned a preparatory study into the technical and institutional factors to be addressed with a view to undertaking comprehensive reforms in water and waste water management. Following this, on May 21 and 22, 2004, a workshop was held for the Delhi Urban Water and Sewerage Supply Improvement Project (DUWSSIP) where DJB officials were joined by representatives from the Union Urban and Water Ministries, Public Health Board and Ground Water Board, officials from Delhi municipal and state government, representatives of the World Bank, Water and Sanitation Programme, and other international agencies. The workshop was moderated by PriceWaterhouseCoopers (PWC), but they were not named on the participant list. The World Bank was later accused of unfairly intervening in the tender process in favour of PWC (IPTsecretariat, 2007; Ramesh, 2005; Sampat & Koonan, 2012; World Bank, 2005, 2009). Additionally, members of several Indian water boards (Bangalore, Hyderabad, Chennai, Mumbai and Jamshedpur) as well as staff from both Manila Water and Johannesburg Water, a joint venture with Suez Environment made presentations on transition to private sector involvement (Delhi Jal Board, 2004c, p. 10). In 2005, four companies, Manila Water, Degremont (a Suez subsidiary), Veolia and Saur were shortlisted to run PPP distribution projects in South Delhi (V. Asthana, 2009, p. 93).

In late 2004, following the reform workshop, the DJB announcement a water tariff increase (Maria, 2008, p. 12). This was met with a concerted response from activists, NGOs and citizen's groups (Shiva, Vandana, 2006, p. 12; Avjeet Singh, 2008, p. 421)[199]. Public feeling was partly built on dissatisfaction following electricity privatisation in Delhi[200]. In this movement against the privatisation of Delhi's water, the current Chief Minister, Arvind Kejriwal, was a key figure. This curtailed the proposed project (Gulati, 2015; Kejriwal &

[199] For more on this period see (V. Asthana, 2009; Maria, 2007)
[200] Personal communication, Awadhendra Sharan, Centre for Study of Developing Societies, Delhi, 20/08/14, fieldnote3 (fnX subsequently)

Bhaduri, 2005) to the extent that even some water researchers continued to regard privatisation at 'stalled'[201]. Nevertheless, in 2012 projects in three areas of the city were launched, with little fanfare, as projects 'in the PPP mode'. These three PPPs are operated by Suez, Veolia and SPML Infra; as noted above, two of these companies shortlisted previously for involvement in private sector water management in Delhi. The DJB declines to comment on the continuity of the current PPP water projects in Delhi with the earlier DUWSSIP project (Sampat & Koonan, 2012). **P**ersistent opposition to water privatisation, however, has continued. While many activists have exceptional grasp of detail and scope, in addition to an exemplary commitment to social justice, the most vocal activists opponents of water privatisation are not always the best informed[202]. Less dogmatic advocates point out that if the poor are not getting water from the state anyway, and are already paying a premium for private sector supply, they will probably not care who runs the service *if* it does improve[203].

The original DUWSSIP proposal stated that private operators would be brought in to manage selected zones, at first on a competitive basis, with the intention of testing if they were able to improve supply in a complex and dense urban environment, and with the aim of scaling up successful pilots to cover the city as a whole.[204] In response to a question in India's Rajya Sabha (House of Lords) on the 14th August 2015, the Minister of State for Home Affairs, Kiren Rijuju, observed that 'in future these water supply improvement projects can be undertaken by DJB through its own staff having gained experience and expertise'[205]. This demonstrates the idea at the City and National level that the public utility can learn from the private sector and then bring this knowledge back into their own management of the network when the contracts expire. These PPP projects are thus presented as a way to assess and develop private sector competencies at working in the Indian urban water

[201] Personal communication, Awadhendra Sharan, Centre for Study of Developing Societies, Delhi, 20/08/14, fn3
[202] I have attended meetings on water with ActionAid, International Environmental Law Centre, *Jan Pehel* (Madhya Pradesh), *Manthan Adhyayan Kendra* (Madhya Pradesh), National Platform Against Water Privatisation and People's Campaign on Right to Water (Karnataka); Citizen's Front for Water Democracy; Delhi National Law University; Development Alternatives; *Himdhara*; *Jal Samvaad*; *Namada Bachao Andolan*; National Campaign Against Water Privatisation; WaterAid.
[203] Personal communication, Dunu Roy, Hazards Centre, Delhi, 21/08/14, fn4
[204] Interview with senior urban researcher, Delhi, August 2015, fn44
[205] Ministry of Home Affairs 2014, online: (V. Asthana, 2009, p. 93)

context, with an eye on the future rollout of urban water networks in the future[206]; 'if you have all these areas and system is not working very well, why not try out what could be improved in a couple of places?'[207].

Can Delhi's water service be reformed and modernised along more commercially, and ecologically, efficient and sustainable lines by following technical expertise from multilateral and bilateral agencies and multinational corporations? This would function as a 'test bed' or 'poster child' for good public sector governance and creditworthiness for both Delhi and India as a whole. The Delhi Metro would be an example of a successful project of this type (Bon, 2015; Siemiatycki, 2006). Consider, for example, this description of a water PPP in Delhi:

> 'The New Delhi contract confirms our position as the leading company on the Indian market. In addition to being a symbolic victory in one of the most dynamic capitals in Asia, it also testifies to our ability for form partnerships with the leading local firms and to stand out for the excellent services provided and our social responsibility. It also, and above all, reflects the trust the Indian authorities have placed in us for the long term' (Veolia, 2012).

Given this symbolic value, Delhi is the site of a proliferation of experiments in water treatment, distribution and reuse. Closely involved participants in Delhi's water sector mention that:

> 'DJB was originally talking about reforms with the idea that private could come in in the south and that DJB could do reform pilot under own management in north - but there were other reasons why private sector was brought in everywhere'[208].

The PPP at Malviya Nagar (Malviya Nagar Water Services, 'the Project') officially began in 2011-2012. Malviya Nagar Water Services is a joint venture ('the Operator') created between a Multinational Water Company[209] ('the MNC') and an Indian infrastructure

[206] Personal communication, senior manager, Project Offices, Delhi, 19/09/14, fn6
[207] Personal communication, Senior Urban Researcher, Centre for Policy Research, Delhi, August 2014, fn44
[208] Expert roundtable on water management, Development Alternatives, November 2014, fn38
[209] Suez Environment. It might be advisable to keep them anonymous.

company[210] ('the Local Partner') for the zone of the PPP. In 1947, the Malviya Nagar area was largely village farmland on the edges of urbanised Delhi. In 1948, land for refugee colonies in the south, at first Malviya Nagar and neighbouring Kalkaji, was selected. The agricultural land, growing 'rows and rows of vegetables', was purchased for a 'pittance' from the farmers by the district board as well as private developers (Sengupta, 2007, p. 80). Many other South Delhi neighbourhoods also came into existence as refugee colonies.

Today, Malviya Nagar is well-placed in South Delhi. Despite its associations as a fairly wealthy (certainly solidly middle class) area of Delhi, the PPP zone is substantially larger than simply Malviya Nagar colony and covers a diverse range of settlement types with a population of around 400,000 (Delhi Jal Board, 2017). This includes very affluent areas (for example, Geetanjali Enclave), less ostentatious but still comfortable Delhi Development Authority (DDA)-built areas, a very large area of government housing (which has its own arrangements with the DJB as well as extensive tubewell supply), a large cluster of unauthorised colonies (including Khirki Extension and Hauz Rani Extension), urban villages up to a thousand years old (including Hauz Rani, Khirki and Begumpur), a small number of recognised slums, and a few *jhuggi jhompri* clusters or unrecognised slums. There are also significant commercial sites including run-down public hospitals and luxurious private hospitals, five star hotels, and high-end shopping malls. The PPP zone, which is T-shaped, can be divided into four bands, north to south (see Figure 13, page 79). The top 15% of the zone is richer and planned, the next 10% composed more of DDA flats and unauthorised colonies, the next 10% is mainly malls and hospitals, the last 65% is peri-urban and unauthorised colonies (e.g. Dakshin Vihar) and 'farmhouse' villas. This mix of land-use gives a more varied and challenging environment for the operator.

In conversation, the member of staff responsible for Non-Revenue Water (NRW), Arjun, disagreed with my suggestion that Malviya Nagar is a rich area and an easy place to do the project. Some parts are wealthy, he agreed, but the unplanned neighbourhoods and urban villages are not. He described the project as 'very difficult, very challenging, very interesting, very stressful'[211]. The zone of operations for the Project itself has been

[210] SPML. It might be advisable to keep the anonymous.
[211] Personal communication, project staff, Project Offices, Delhi, 19/09/14, fn6

artificially constructed across DJB zones (it is broadly within South II), Member of Legislative Assembly (MLA) constituencies and a mix of land use types. There would be an argument for creating an administratively artificial zone if it could be hydrologically isolated, but this does not seem to be the case (see description of 'irrational' zoning in *Chapter Four*). After four years of work Project staff have 'nearly' identified all the places where water enters in bulk from the main network ('inlets') but there are still 'one or two we are not sure about, maybe they exist'[212]. The process by which Project zones were chosen would repay further research.

The PPP is an operations and management contract in which the Operator will manage the assets and service for 12 years. Operations and management contracts are considered the 'lightest' form of PPP, as the public sector retains ownership of the assets. The contract is for 2+10 years; a two year period is given for 'rehabilitation' of the physical network (including reducing leaks and laying new pipes) and the Operator has ten years after this to manage the network and recoup their investment. After 12 years, the network assets and management will either be passed back to the Delhi Jal Board, the contract will be renewed or another operator may come in. The project aims to turn a section of Delhi's water network into a financially viable commercial venture, with more people receiving water from the utility and less water and money wasted.

The consortium is required to increase coverage of water supply (from 84% to 100%), bring down the per capita supply (from 286lpcd to 150), increase supply hours (to 24/7 from current 3-8), increase metering of water connections (from 41% to 100%), bring down non-revenue water (from 65-70% to 15%), increase cost recovery of operations (from 61.4% to 100%), increase collection efficiency (from 81% to 90%), increase quality of water supplied, and increase efficiency in addressing complaints[213].

As a service contract, Operator profits are independent of income from tariffs which are set by the DJB. As the Delhi Jal Board is essentially paying the Operator for the service of providing water to users in the zone the DJB should be seen as the real consumer.

[212] Personal communication, Project manager, Project Offices, South Delhi, 21/04/15, fn56
[213] Malviya Nagar PPP Detailed Project Report, Contract. Copy with author.

Remember the World Bank 'best practice' automatic tariff increases from Chapter Four? Basic services and price increase (*mahengai* – inflation) were key issues in the 2014 and 2015 elections. Delhi's Election Commissioner suggested that the rise in the water tariff was partly responsible for the previous Congress Party Delhi government's collapse.[214]

The most positive thing about this PPP is the claim from the Operator is that they are working to 100% connection in the project area[215], a markedly different approach from the DJB's differentiated supply modes.

> "We are clear that […] the hydraulic model, implementation plan, masterplan whatever you want to call it, is based on providing water to everybody, authorised, unauthorised."
> (Personal communication, senior manager, 21 April 2015, PPP Offices, South Delhi, fn56)

However, this is subject to DJB approval in unauthorised colonies and there is no contractual obligation to supply to areas (like recognised slums) that are 'outside of DJB scope'[216]. As Mr Levé, quoted above, explained, MNC staff were not initially aware of the restrictions on supply to unauthorised areas, and this has delayed the project. Additionally, approval to replace pipes is case by case for different areas, and 'there are different cases even by DJB'[217]. Further, contractual penalties related to this objective only apply within 40 metres (a maximum distance of 100 metres is allowed in unspecified circumstances) of where the network is laid, and unauthorised colonies are an 'allowed exclusion' (Delhi Jal Board, 2012, pp. 1992–1993). This appears to continue the approach of supplying only to the edge of unauthorised areas and allowing self-laid pipes internally. This is certainly an issue that project staff are now aware of. These will also be metered connections, an option which is not popular with local residents (Delhi Jal Board, 2012, p. 2115)[218]. The terms and conditions of these connections then become the terrain over which the extent and quality of service is negotiated.

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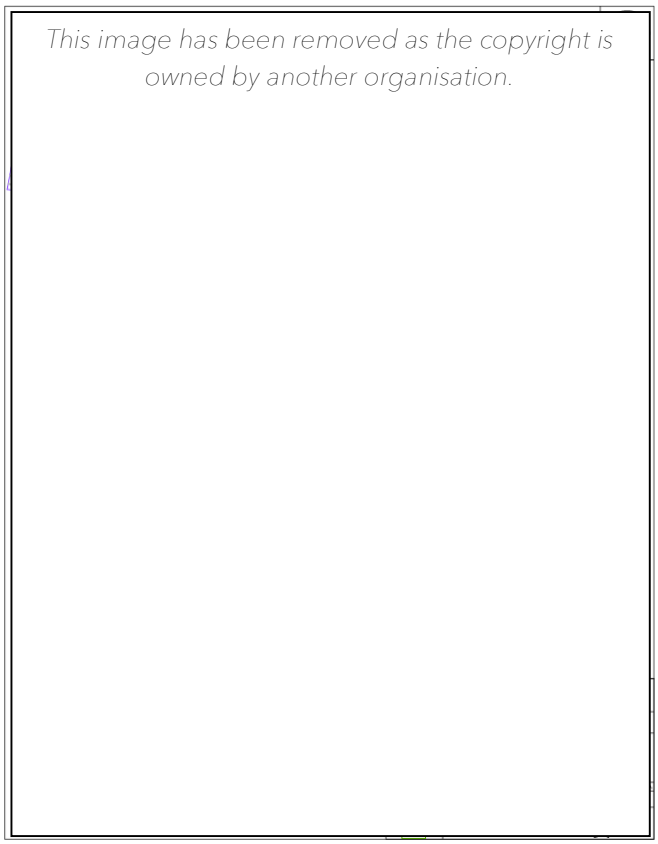
[214] Personal communication, Delhi Election Commissioner 15/09/14, fn45
[215] Personal communication, PPP Project Manager, 21/04/15, fn56
[216] Slums are supplied water by a different agency
[217] Personal communication, PPP Project Manager, 21/04/15, fn56
[218] Personal communication, local politician, Hauz Rani Ext, September 2014, fn49; Personal communication, Khirki Gaon RWA president, 21/01/15, fn14; see Appendix MR, page 290

The Operator won the contract on the basis of their low price of water per connection including technical and commercial losses. This means that their profit margin is based on missing water. The Project is premised on the idea that since water losses in the system are very high (70% according to the Detailed Project Report), the Operator can save enough water to increase the hours and coverage of network supply. The increases in network efficiency are intended to cover the cost of the contract – that is the increases in water saved and income generated will cover the cost of the Operator's profits, and will still be cheaper than if the DJB was running the zone[219]. The DJB suggests that, after accounting for spending on assets, the Operator will break-even if they generate over 15% profit (Delhi Government, n.d.). The 'missing water' is broken into two kinds: a) technical losses or 'unaccounted for water' due to leaks or unknown areas of the network; and b) commercial losses or 'non-revenue water' due to non-payment or theft (note the Arrears column in the table on Water Used and Billed at Appendix WU, page 289).

Arjun, the member of staff responsible for Non-Revenue Water (NRW), explained that in unplanned areas the network has been laid by residents themselves. This makes almost all connections in these areas illegal, as DJB norms are that 100 millimetre pipes must be used and there may not be more than ten metres between the pipe and the house connection. It also means that there is very little institutional knowledge of these parts of the network. "Every extra foot we dig down we find more pipes," Arjun says. The project is "politically, socially challenging, not just technically". He tells me that protests are quite common (about once a month) but: "This is nothing compared to Nagpur and Bangalore! There people get beaten, their heads shaved, garlanded with shoes and their face blackened[220] and made to walk in the streets."

[219] Personal communication, Delhi Election Commissioner 15/09/14, fn45
[220] These are traditional forms of disrespect – like 'tarring and feathering' in the USA.



Unauthorised colonies in the Project zone

Map showing Demand Management Areas in wealthy planned areas used to provide indicative data for the PPP contract. (Detailed Project Report, Appendices and DMA Report, 2011, P272)

A map from a pre-project report for the PPP (shown above, Figure 27) locates the sites used to collect network diagnostics for the contract. They are in some of the zone's wealthier planned areas and highly unrepresentative of the network. In fact, a pre-project report states that these areas were chosen as the only areas where it was *possible* to measure network pressure and water quality (Detailed Project Report, Appendices and DMA Report, 2011). Even in these areas, network water was found to be polluted and mixed with tubewell water. The data ('diagnostics') on which the tender bid was based were prepared by external consultants[221]. Unfortunately, these pre-tender network diagnostics were done in a manner which left the operator needing to redo the work once the contract had started.

> *Two years to do all that work we are supposed to do is too small. It's too ambitious […] The contract in this way it was ideal.* I mean, it was saying that we know everything, we have all the permits […] underground there is no problem, we can

[221] http://dra.net.in/project/reduction-in-nrwufw-with-improvement-in-level-of-setvice-to-the-water-consumers-and-improvement-of-un-interrupted-water-supply-under-the-command-area-of-grlbps-malviya-nagar/

> lay pipe, whatever […] *very weird* that in two years you can lay 200 kilometres of pipe, you can change 50,000 house service connections, it's too small. *It's too ambitious*."
> (Personal communication, senior manager, 21/04/15, PPP Offices, South Delhi, fn56, my italics)

The exact number of connections and their authorisation status is an area where the operator is currently establishing data. The MNC now also has a policy to do a site test before bidding.

> Levé: <pause> at the beginning, the process is that we should have done a network survey to know what is underground and we didn't do it *because we were thinking that the bidding documents were correct*. Bidding documents was given by er, um... <1 sec pause> the consultant who prepared the tender.
>
> Researcher: and [your company] employed the consultants?
>
> Levé: No it was DJB took a consultant, [name removed]. They took a consultant to prepare the bidding documents.
> (Personal communication, senior manager, 21/04/15, PPP Offices, South Delhi, fn56, my italics)

Another project employee spoke about the lack of reliable data they were working with:

> [We] don't have it… don't have digital elevation model, nothing. So we are there struck from scratch, trying to get spot heights out of google earth and then create a digital elevation map. It's just that's loads of work. That is months and months of work in there trying to … you can create these maps but you have to verify them as well, so you have to send these surveyors out to verify them to make sure that certain things are in a certain place. (Perczel, 2016, p. 36)

A former project manager described the situation to me this way:

> There is a syndicate, a mafia. The tanker people are in on it, the DJB is in on it and the politicians are in on it. […] When you are setting things up you work at the top so that your company will be the one that gets the tender. There are different teams that do strategy, planning, design, implementation, operations etc - it's a complete process.

The same consultants also provided input for one of Delhi's other water PPP projects. The Operator for this zone observed dryly that the data they were working from was 'historical'.

The consultants are from Nagpur, known for its PPP in urban water (Nair, 2015), and as well as the Nagpur contract have also been involved in water PPPs in Ahmedabad, Chennai and Pimpri-Chinchwad (for Pimpri, again, see Birkinshaw, 2016). Nagpur is the constituency of former Bharatiya Janata Party (BJP) President and current Highways Minister, Nitin Gadkari, and recent national level urban frameworks (JNNURM and Smart Cities in particular) allow a powerful role for national and international consulting firms in project design (Birkinshaw, 2016; P. B. Mehta, 2013). Difficulties with data have also been found in Maharashtra where consultants have been used in the preparation of PPP bids (Birkinshaw, 2016, p. 58; also Björkman, 2013).

The Project staff at Malviya Nagar also told me that the motivation for the MNC was gaining experience in this kind of dense urban environment with a view to rising future Indian demand. A number of Project staff I interviewed said that India was much more challenging than other operating environments that the Multinational had worked in previously[222]. In Malviya Nagar, neither the Multinational (who had mostly been involved in standalone infrastructure, like water treatment plants and sewage treatment plants, in India previously) nor the Local Partner (who had mainly been involved in rural infrastructure projects) had done this kind of work before. Ironically, the local partner is supposed to be employed to help foreign organisations work in an environment they are not familiar with, however 'both of them are doing it for the first time … since they don't know it they are both having to learn as they go along'[223]. Project staff described their local partner as having insufficient expertise for urban water network rehabilitation, resulting in problems for the Project from government agencies. 'They do such a bad job that they are now given only the easy works and anything sensitive like in a high traffic or residential area is given to [our] own team so that [they] don't mess it up'[224]. I was told that the Local Partner's Delhi team had been put together for the PPP work and had been hiring DJB staff[225].

[222] Personal communication, PPP staff, Malviya Nagar, 19/09/14, fn6; Personal communication, PPP staff, Malviya Nagar, 9/08/15, fn110
[223] Personal communication, Project staff, South Delhi, 23/06/15, fn90
[224] Personal communication, Project staff, South Delhi, 23/06/15, fn90
[225] Personal communication, Dunu Roy, Hazards Centre, Delhi 21/08/14, fn4

Project staff also mentioned that the Local Partner had political connections and that they were unsure how they had won the contract. The Local Partner in the PPP has been implicated in the Delhi Tanker Scam, which appears to have recently cost the Water Minister his job (Lalchandani, 2015a; The Indian Express, 2017a, 2017b). Allegations of corruption were first brought several years earlier by the Water, Sewage and Sewage Disposal Union that the DJB had mismanaged the tendering process for 'Water Tanker distribution service in South and South West Delhi'. The union 'accused the DJB of preconception in the bidding process' to grant the contract to a blacklisted and debarred firm called [the Local Partner] for five years' (Jafri, 2011). This same firm was named in a 2013 report listing major cases of corruption in Rajasthan. The report alleged that the owners of this firm were close friends of Rajasthan's Chief Minister. The close connections between the Chief Minister and two business families were seen as assisting the firm to acquire large infrastructure projects including a dam, irrigation, water supply and road construction work (Parihar & Rahman, 2011). Despite a change of government, from Congress to BJP, this company has continued to be favoured in Rajasthan. A lawyer working on the corruption case stated 'The BJP had accused [the firm] of gross corruption […] but in the last two years, all major projects have been given to this company' (Bohra, 2016). This company is the Operator for one of the three Delhi PPP projects and the Local Partner for another. The project for which they have the sole responsibility has the shortest length of pipeline to be rehabilitated (SPML, 2016).

Despite these challenges, the Project has been successful at realising a key goal. One of the main objectives, indeed 'an obsession' for the Multinational, was the introduction of continuous pressure service, or 24/7 as it is known in India. It is to this aspect of the project that we now turn.

TWENTY FOUR SEVEN 'OBSESSION'

The American origins of the 24/7 ideal can be felt in the translation to '24 by 7', as it is known in Indian English. The term means 24 hours a day, seven days a week. The distance from the ordinary realities of many cities can be heard in the question from a resident to a consultant whether this improvement would mean seven hours in 24 days. 24/7 is

essentially shorthand for a move from intermittent to consistent pressurised supply. A model of 'rationed' or intermittent supply is the norm across Asia. As water is pumped from larger ('transmission') pipes to medium ('distribution') pipes, to small ('tertiary') pipes (known as 'ferrules'), at neighbourhood level pressure fluctuates depending on quantity released, proximity to pumps, interaction with other flows which may be coming from different inlets, slopes, pipe diameter, turbidity and other factors. At neighbourhood level some amount of pressure is directed to a particular neighbourhood or street for times of between 30 minutes and four hours. Low-level workers control the water timings, by opening and closing valves and operating booster pumping stations and tubewell motors at certain times. The water timings rotate unequally across neighbourhoods in order to distribute water between them (see analysis of water timings data in Chapter 4). During these times water is available in the pipes. However, in reality the pressure is usually insufficient to reach households, especially above ground level. For this reason all water users, including the Project and DJB offices, use booster pumps, known as 'motors', to increase pressure[226]. A continuous pressure system would smooth out the irregularities in the pressure at zonal level and supply water to the household at a higher constant pressure.

24/7 water has been widely promoted as an advance model of water management that public utilities in India should move towards. It is now a Service Level Benchmark (normative target) of the Indian Government and is often promised when reform projects are initiated (V. Asthana, 2013; Kamath et al., 2009; Sangameswaran et al., 2008, p. 7; Vyas, 2009). Several advantages are claimed for continuous pressure supply (World Bank, n.d.), not least the ability to calculate the amount of water sold, stolen and lost. By using thinner diameter pipes the same amount of water can be distributed at higher pressure and for more hours[227]. This would help to address the Project objectives for increasing per capita supply and supply hours. Replacing the pipes and increasing the pressure should also improve non-revenue water (by reducing leaks) and quality of water (by reducing ingress). Constant pressure prevents ingress from surrounding soil during low pressure. This is said to be a common reason for low water quality, although some people claim that the water

[226] Personal communication, PRO, PPP Offices, Delhi, 21/04/15, fn55
[227] Personal communication, Partha Mukhopadhyay, Centre for Policy Research, Delhi 06/08/15, fn124; Personal communication, Project worker, November 2015

from the treatment plants is insufficiently clean 'so fixing the distribution network will not help'[228]. Continuous pressure is also said to prolong the life of the pipes, as the water 'hitting' valves and junctions as pressure comes on and off causes them to break. A dependable continuous pressure supply would also mean, in theory, that consumers could dispense with suction pumps and water storage which often leads to wasted water. The manager of one of Delhi's other PPPs stated to a meeting of experts that in their 24/7 pilot zone consumers had started to abandon storage tanks and motors, but in both Malviya Nagar and in Karnataka, this has not been the case after continuous supply has been arranged (Burt & Ray, 2014).

From the operator side, continuous pressure is needed to be able to perform hydraulic modelling, which is contractually required (Delhi Jal Board, 2012, p. 1937). The application of sophisticated information-based techniques like this to the network is the area that foreign companies can offer additional expertise in. In conversation with staff working with the multinational partner in the project in France and Delhi, it appears that 24/7 was an important element for the higher levels of management – an 'obsession'[229] – at least in France. In the US and Europe, an intensive engineering approach to advanced public networks has allowed business improvements for utilities managed with a high-level of technical know-how.

> 'in this scope of 24/7, transition to 24/7, we had thought that it's an obsession of [the MNC] and it's a cultural thing that [the MNC] all over the world is implementing 24/7 so they cannot find the business model in intermittent supply, that's why they push 24/7 because it's the only thing they know […] finally what we understood is that seriously they have a perfectly clear idea engineering-wise what is going on, they have a very clear idea how much better continuous supply is to intermittent supply […] They are a very engineering-driven company, they know what's going on, they have expertise, they know about hydraulic models, they know everything...'
> Personal communication, PPP staff, Delhi, 9/08/15, fn110

[228] Personal communication, Dunu Roy, Hazards Centre, Delhi 21/08/14, fn4
[229] Personal communication, PPP staff, Malviya Nagar, 23/06/15, fn90

However, while the approach had worked in some other contexts, with Algiers and Jeddah being best case examples to follow, the context in India is very different, 'the most difficult environment to work in'.[230]

> 'so they had seen [24/7] and then they had lost it, and in Algiers there was 24/7 and because it was going it was intermittent supply and then [the MNC] brought back continuous supply, so they were asking for that, and here it wasn't like that, and neither the population neither the local politicians, like at least in [names a large Indian city], there is a team of the municipality in charge of supervising [the MNC] work and they are not really convinced that it's useful' <laughs>
> Personal communication, PPP staff, Delhi, 9/08/15, fn110

DJB map of Zone 43. My red circles indicate the unplanned areas. (DJB 2008, Copy with author)

Twenty four hour continuity of supply is stated as a Performance Target in the PPP Contract; however, operator fees are attached to pressure during scheduled supply hours, not literally twenty four hour supply (Delhi Jal Board, 2012, pp. 1989, 1997). The contract at least recognises the considerable difficulties in engineering around-the-clock uninterrupted supply.

[230] Personal communication, PPP staff, Malviya Nagar, 23/06/15, fn90

To calculate pressure and water distribution, the Operator needs to know the network, not just in one neighbourhood but across the zone. As mentioned earlier, this an area in which the MNC found themselves underprepared by the pre-tender information that they had. The land use mix in the Project zone is not felt to have been easy for the Operator; it is regarded as overly challenging and stressful[231]. A number of interviewees referred to the creation of the zone as a 'test' for the private contractor set by the DJB. After four years of work, they are still unable to locate all the points at which water enters their section of the network. They have found eight but there are others they have not located[232]. It is noticeable that the DJB maps of the zone have large blank spaces where the unauthorised colonies, urban villages and slums are (see map page 199).

> "Nobody knows how much demand is there. It is an unknown demand. The number of units and people per dwelling [are unknown]. You could be wrong by a factor of 100, 200!"
> (Personal communication, Public Relations Officer (PRO), PPP Offices, Delhi, 21/04/15, fn55)

> [DJB] gave us census data and that was it. Census data was also old by then. It was 2011 census data and this was working in 2015. Now this is Delhi between 2011 and 2015, is a big difference. So we […] tried to do their own survey sending surveyors out on the ground sending surveyors out the houses to note down the number of people, note down the number of floors in the building. Just basic stuff like that. Unfortunately, even these surveyors, either they weren't well trained or they weren't well supervised. Cause they'd go and count the number of floors and make an abstract total of what number of people they think could live in the building and come back with it. (Project staff quoted in Perczel, 2016, p. 38)

Pipes connected to the network have not necessarily been laid with the awareness of the DJB, and are likely to have been re-laid several times and, again, modified piecemeal. People lay pipes themselves in both unauthorised and authorised areas, and 'plumbers' will dig up the roads routinely in unauthorised areas where 'no-one cares what you do'.[233] Private plumbers digging up roads to work on water or sewer connections, often under the supervision of a shopkeeper, householder, or Residents Welfare Association (RWA) member, are a fairly common site in urban villages and unauthorised colonies in the zone.

[231] Personal communication, PPP staff, 19 September 2014, 21 April 2015, fieldnote 56
[232] Personal communication, PPP Project Manager, 21/04/15, fn56
[233] Personal communication, local residents, Khirki Extension, 11 July 2015

In some areas there are also public tubewell networks, which the PPP staff have no control over.[234] The tubewell networks, using untreated groundwater, are in some places connected to the treated water network pipes. These kind of amendments means that knowledge of the network is highly fragmented at best.

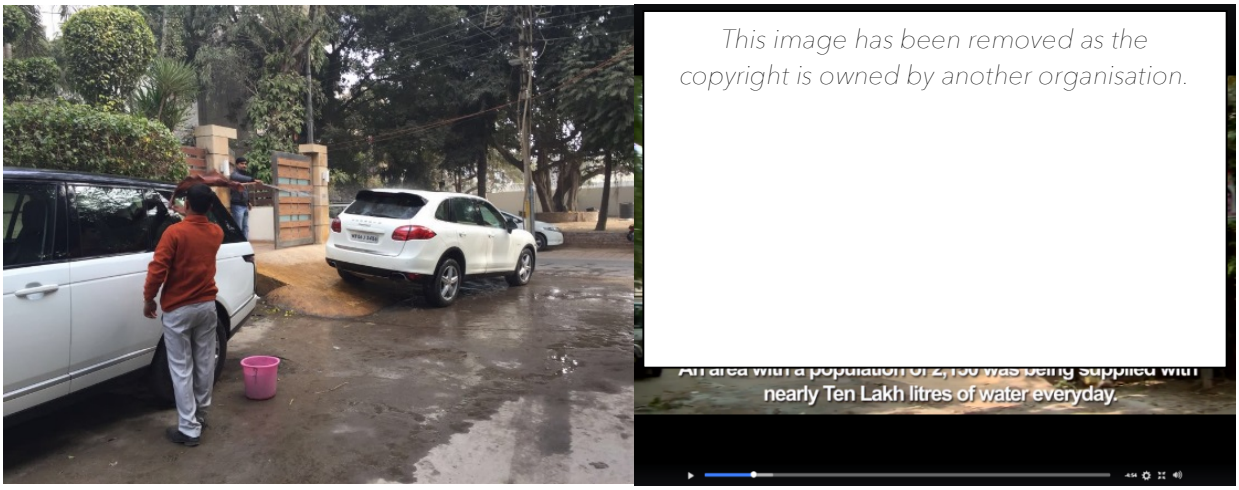
> 'in some areas we don't know what is underground perfectly so when we do some works then we have to stop because we found out that there is a drain or there is a sewer coming on the way so you have to stop'
> Personal communication, senior manager, 21/04/15, PPP Offices, South Delhi, fn56

Zonal inlets, outlets, junctions and valves are the most important parts of the network that can be difficult to locate. Valves in places where they are not anticipated can lead to breaks and leaks. At one spot in the zone, the operator's staff had found a valve that had been buried underground (as was common practice under the old system) and lost. As the valve had been closed this had meant that a section of houses nearby had not been getting government water for many years but no-one had been able to tell them why.[235]

Although a focus on higher income areas is not specified, pragmatically this has been the case with project 'priorities' in order 'to make progress'; and while low-income unauthorised areas were chosen for NRW reduction, wealthy planned areas were used to pilot continuous supply[236]. Given the large and complex zone, the Project staff chose to focus their 24/7 pilot on one of Delhi's wealthier neighbourhoods, across the road from the PPP offices. Interestingly, DJB schematics of the area appear to show a direct dedicated line for this neighbourhood from Delhi's new PPP built Water Treatment Plant. In this gated enclave of palatial residences and leafy parks, complete with a club house and lawns, the operator has been able to isolate and comprehensively map the pipe network and deliver 24/7 supply.[237] However, even in this elite planned area, the water network had been modified, significantly in some cases.[238] The area is triangular. Unfortunately for one of the

[234] Personal communication, PPP staff 21/04/15, fn56; 19/09/14, fn7; Personal communication, Khirki Gaon RWA president, 21/01/15, fn14; Personal communication, local resident, Khirki Extension, 5/03/15, fn27
[235] Personal communication, PPP Project Manager, 22/07/15, fn98
[236] Personal communication, PPP Project Manager, 21/04/15, fn56
[237] Personal communication, PPP staff, Malviya Nagar, 19/09/14, fn6
[238] Personal communication, PPP staff, Malviya Nagar, 9/08/15, fn110

area's more influential figures, his residence was in the corner of the triangle. As pipes were laid in a branched network, this house was at the tail end and received the lowest pressure in the area (for branched and loop networks see Swamee & Sharma, 2008, p. 65). When Project staff were preparing the area, they found that the network had been converted to a loop system outside this house, in order to raise the pressure[239].



Cars at the 24/7 pilot get their daily bath (left) (Image courtesy Juli Perczel); Promotional video for 24/7 pilot (right)

The transition to continuous pressured supply has led to a number of complaints in the areas where it has been trialled. Households in this area were not well-informed of the move to a continuous pressure supply, and were used to obtaining intermittent supply. Water use in this area was extensive, and wealthy residents would have their expensive cars washed daily. Consequently, the transition to 24/7 or 'continuous pressure' supply, which delivered more water at higher pressure for continuous hours, led to a high level of water being wasted through leaks and taps left open. As consumers' bills were generated from meters readings of their water supply this led to some very high bills (₹5,000, ₹8,000 - £50, £80 a month) and a large number of complaints (around 60 'serious') from surprised residents.[240] An irate elderly resident in an urban village showed me a bill for ₹30,000 (£300 at time of research) for the year[241]. The World Bank recommends sending 'dummy bills' to

[239] Personal communication, PPP staff, 9/08/15, fn110
[240] Personal communication, PPP staff, Malviya Nagar, 9/08/15, fn110
[241] Personal communication, RWA president, urban village (Hindu / dalit), south Delhi, 21/01/15, fn14

raise consumer awareness of their usage and liabilities under a volumetric system[242]. However, the operator did not communicate with the residents in advance of the change, so the first residents were aware of it was when their bills arrived. Limited communication in response to the complaints did little to mollify residents.

> "One guy had a ₹60,000 [£600] bill. The internal audit took around three months to get back to him, in this time he received another bill. He hit the [Project] workers. He is about 80!"
> Personal communication, Project staff, 10/07/15, Delhi, fn94

Subsequent to these kind of reactions, the operator has reduced the supply hours to sixteen and is trying to redress wastage by free leak audits 'after the supply point' and provision of 'float valves' (an inexpensive mechanism which closes the inlet to a full water tank).[243] The leak audits 'after supply point' are on the consumers property, which is not the responsibility of the operator, but they are offering the service as an indication of good faith. Unfortunately, there has been little take-up for either audits or valves. Estimates from the Bengaluru water board suggest that 60-80% of leakage is on customer connections before the meter – on the ferrule and the connecting pipe (Delhi Jal Board, 2004b, p. 9). However, residents were quite happy with their water supply before and do not appreciate the changes or even want to think about them.[244]

> Mr Levé: From four hours per day we came up to sixteen hours, yeah. *But*, but, but in Geetanjali I came down to 12 hours a day and [Colony Name] to six hours a day. […] *Why*? [rhetorical] It's because for the time being the people are not aware of this improvement, ok. They don't see that they have water all the time, because the water is going to their underground tank, and after that they pump when they used to pump. So they don't see that they have water 24 hours because the water is not going directly to the tap. It's all one system of underground tank - overhead tank. So, it's the buffer that prevents people to see that if they take the water directly from the pipe, they can open the tap any time and they will have water. They don't see it. Secondly, the point is that putting more water 24 hours in the pipe, I saw that I had some high NRW in our pipe. So we are repairing a lot of leaks and a lot of leaks after the meter, in the premises of the customer - because their

[242] Expert roundtable on innovation in water and sanitation services, Development Alternatives, November 2014, Chatham House rules, fn38
[243] Personal communication, PPP staff, Malviya Nagar, 23/06/15, fn90
[244] Personal communication, PPP staff, Malviya Nagar, 23/06/15, fn90

> underground tank were leaky… because their internal plumbing were leaky… because their overhead tank was overflowing… so they had a very high bill
>
> Matt: So […] the bill is high because they're wasting water?
>
> Mr Levé: Exactly, but they never accepted that. They saw only the high bill and they said that the high bill comes because of new meters. So they put the responsibility on our new meter instead of their own uh, internal leakage. Ok, so they were more focused on not paying the bill, finding excuses not to pay the bill than tackling their own problem.
> Personal communication, senior manager, Project offices, Delhi, 21/04/15, fn56

DJB data on water consumption after meter replacement shows that consumption in Geetanjali, the wealthy enclave where the 24/7 pilot is, doubled after meter replacement suggesting that these were indeed high consuming households who had previously been getting average bills (see Appendix MR, page 290).

Remember the Project staff getting a slap from the elderly gentleman with a £600 water bill? Project staff had been working with the project to understand consumer complaints in the 24/7 pilot area. They explained that '70-80%' of users were happy with a switch to metered bills, 'when we shifted to meters they paid less', because their consumption was below average. However, a small number of households faced very large bills after the switch due to leaks and heavy water use. Consequently, when moving from an all-Delhi average bill to their actual use, their bills soared. These households had 'built strong habits' of water use, 'like gardening, which means they are high society'. The high consuming, wealthy households were able to make their complaints 'really noisy', because 'they know people […] which means political pressure'[245].

Unfortunately, the technical and social challenges meant that the Multinational expertise was underutilised. The environment was described as an 'immature market'. The highly technically specialised foreign staff were too expensive relative to the returns they might be able to deliver, as the network was too unstable (and unknown) to be able to benefit from their skills.[246] The PPP staff I spoke to suggested that they were not worried about significant financial losses - for example from the AAP 600k free water scheme described in

[245] Personal communication, PPP staff, Malviya Nagar, 9/08/15, fn110
[246] Personal communication, PPP staff, Malviya Nagar, 9/08/15, fn110

Chapter 3. While they were confident they would get paid for one way or another, by bringing in lawyers if necessary, they seemed to feel it unlikely the Project would make substantial profits and described its value to the company as being more about gaining experience and reputation in the Indian environment where demand was sure to rise[247].

For knowledge of water flows and increased revenue, meters on customer connections are essential. However, we have seen here how the transition to metered supply and volumetric billing is not popular, even in the wealthiest and most and technically feasible areas. This aspect of the Project has been a source of further challenges across the zone as a whole, especially in unplanned areas.

UNPLANNED AREAS

Unplanned areas have higher population and built up density than surrounding areas, as can be seen from the DJBs own data (see Appendix PD, page 291). For laying pipes, checking connections and installing meters, unplanned areas are considerably more challenging. For residents also, water is a problem. After my first few months living in a high-density urban village with irregular water connections, my fieldnotes record that my neighbours and other residents 'are always shouting and often talk, argue about water - like "*paani lao*" [bring the water here], "*paani kahaan hai*?" [where is the water], "*paani aa raha hai*" [water is coming]'[248].

> Researcher: What is the plan?
> Mr Levé: There is no plan! People are always making pressure. They want more hours, want more water. But they are motivated by politicians.
> (Personal communication, senior manager (male 45), Malviya Nagar, 19/09/14, fn6)

Unplanned areas have historically been neglected by the Delhi Jal Board, with water pipelines either laid at residents' expense or in some cases through discretionary funds from the MLA or local counsellors. There appears to be a process of 'formalisation'. Initially, no water is given. Then government hand pumps or tubewells may be provided. Pipes may

[247] Personal communication, PPP staff, Malviya Nagar, 19/09/14, fn6
[248] Notes, urban village, south Delhi, 8/09/14, fn5

also be self-laid from tubewells or neighbouring areas. Local politicians often finance the construction of infrastructure from their discretionary budgets. These processes are highly contingent.

Unauthorised colonies in project zone

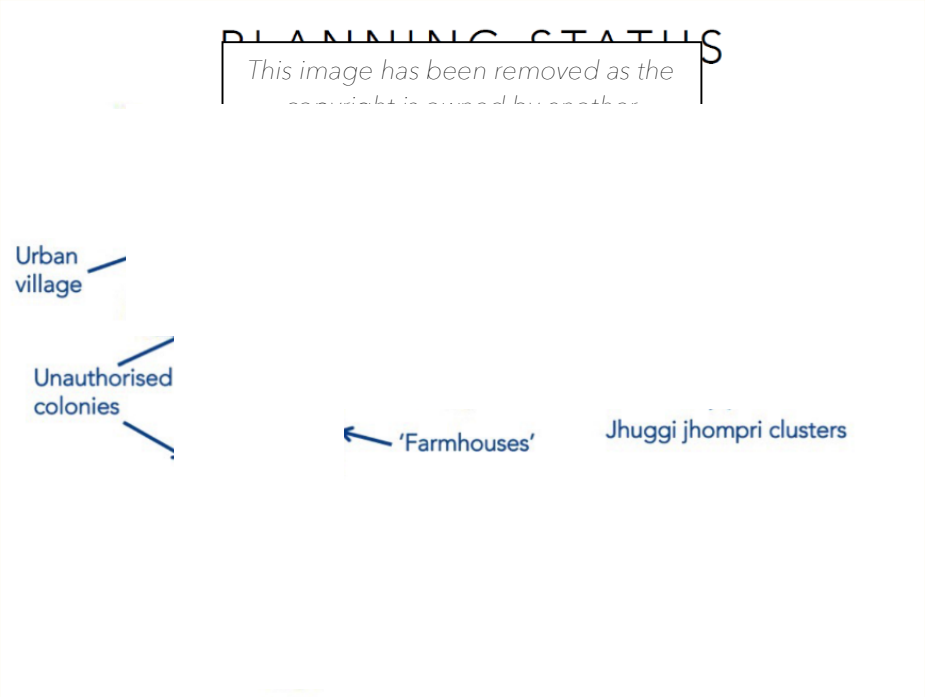
> Tasleem: All water [in our area] is from tubewells. The TDS [total dissolved solids, a salinity and pollution measure] is 1200. We should get treated water; Hauz Rani Extension doesn't but Khirki Extension does.
> Researcher: Khirki gets it but not Hauz Rani! Why?
> Tasleem: Just like that, no reason
> Researcher: What does the government say?
> Tasleem: Nothing, they are all sleeping.
> Personal communication, local politician (male, 45), Urban Village Extension (Muslim), South Delhi, September 2014, Hindi, fn49

Tasleem's concern is well-placed; DJB chemical analysis of water from 24 tubewells in the PPP zone found only three supplying water fit for drinking (DRA Consultants Pvt. Ltd. & Shah Technical Consultants Pvt. Ltd., 2011a, pp. 192–194).

Because of this official neglect, unplanned areas are hot spots for unauthorised or illegal connections. The map below is taken from the Detailed Project Report (DPR). A large copy was placed on the wall opposite the project manager's desk and was being used to prepare a quick shortlist of places to target for NRW reduction; urban villages and unauthorised colonies[249]. The map shows connection status, not planning status. However, familiarity

[249] Personal communication, senior manager (male 45), PPP Offices, Delhi, 21/04/15, fn56

with the area has allowed me to annotate it to highlight that the concentrations of unauthorised connections are also unplanned areas.



Map showing project zone. Illegal connections in red, unknown yellow, bulk pink, authorised green. My annotations. Source: PPP DPR, copy with author.

To date, the Project objective of increasing the number of metered connections has proved a challenge as customers without a meter do not want to move to metered consumption. Installation of water meters has particularly been an issue in villages, unauthorised colonies and slums. DJB online progress reports suggest that meter replacement is proving unpopular stating that work is making 'slow progress due to resistance from public' (Delhi Jal Board, 2014a). Pre-Project data from the DJB also indicates problems with meter installation and replacement, especially in unplanned areas. The table at Appendix MR, page 290, shows that only one meter was able to be replaced in Hauz Rani and only 34 in Khirki. DJB data (at Appendices WU and PD, pages 289 and 291) describes Hauz Rani as having 14,426 residents and 937 consumers. The same data describes Khirki village and extension as having 2834 consumers and 43,567 residents. The low number of official connections was supported by conversations with residents. In one dense low-income neighbourhood in the Project zone, I was told that people are not using meters and they won't accept them.

> Tasleem: If there are a thousand homes, then 50 have meters and the rest have unauthorised connections. But that new company says that if you have meters then Sonia Vihar (e.g. treated) water will come, if not then it won't.
> Researcher: So this means that those other people will still be getting normal water, groundwater?
> Tasleem: Yes
> Personal communication, local politician, Urban Village Extension (Muslim), South Delhi, September 2014, Hindi, fn49

However, if residents are unwilling to accept a meter from the Operator they will be left on the old network or relying on alternative sources.

> Levé: …our idea, and of course for them, of course they want to switch to the surface water because the tubewell water, the hardness is very high, sometimes it's contaminated, they can't drink it and it's [an] energy cost also, so for them phasing out the tubewells it's a saving and it's a, improving the quality of the water
> (Personal communication, senior manager, PPP Offices, South Delhi, 21/04/15, fn56)

It is also worth noting that the tubewells supplying groundwater to unauthorised areas within the project site remained the responsibility of DJB staff under the PPP contract. Capture of tubewells by local residents and diversion for their personal use was remarked on by respondents and observed in the PPP site as well as other areas of Delhi (see Chapter Six).

> "There are 1, 2, 3, 4, 5 tube wells in this area [points in various directions, an arc going south to north east]. I cannot show you for my own safety. These are government tubewells, but they get captured"
> (Personal communication, real estate dealer, urban village (Hindu), South Delhi, 21/01/15, fn14)

> "Tubewell people will just come anytime and the key will be kept with local people. They turn it on when they feel like and maybe tell their friends."
> (Personal communication, RWA President, urban village (Muslim), South Delhi 10/03/15, fn28)

The Project contract stipulates that they must phase out tubewell supply. However, Project staff said that the phasing out of tubewells was unlikely to be successful as the project was not receiving sufficient bulk water from the DJB. Curious about the relationship of tubewell

water and treated supply, I asked the project manager whether the tubewells and treated water were supplied through the same network, or parallel pipes.

> Researcher: Are [the supply from tubewells and the treated supply] in the same pipes or is it separate pipes?
> Levé: *Haan*... [Hindi – 'yes'] today, they are separate pipes, but er <3 second pause> in some area we know that they are connected to the existing network. [Pause. Interviewee becomes very hesitant here] It will be case by case but what I can tell you is that since the beginning we arrive we phased out 60 tubewells. […] Here is the big question mark we are needing to discuss with DJB, that as they are not providing the contractual volume that they are supposed to give us, like 83 [million litres a day, MLD], so we have today we have seven MLD er difference. So we will have probably to still use some tubewells for a couple of time to satisfy the demand of the customer." […]
> (Personal communication, senior manager (male 45), PPP Offices, Delhi, 21/04 /15, fn56)

It seems that insufficient water was being supplied from the Sonia Vihar treatment plant, also a PPP project (in fact by the same company). Sonia Vihar, was originally intended to give dedicated supply to the PPP pilots. However, Sonia Vihar is not providing the quantity originally intended, and that too is being distributed to all of south Delhi, not just the PPP zones. Other researchers, however, told me that Sonia Vihar was not producing enough bulk water. This was attributed to insufficient bulk water being generated by the Sonia Vihar treatment plant, also a PPP project, in fact by the same company (InKhabar, 2013)[250]. From conversations with project staff it sounded like water from Sonia Vihar had been allocated to other areas, and the Project was receiving water partly from Sonia Vihar and partly from the Haiderpur Water Treatment Plant. Mr Levé agreed that that the insufficient bulk water would impact the project profit margin, but also said that this was something they could 'negotiate'. He also suggested that the Project was contractually protected against financial impacts of the AAP's free water scheme.

Across the road from the urban villages and unauthorised colonies I have been describing is a complex of three expensive shopping malls. The malls are not DJB or Project customers, and arrange their own supply through tankers and tubewells. This puts a lot of stress on the

[250] Afsar Jafri, Focus on the Global South, meeting August 2013 (Jafri cited for same point in V. Asthana, 2009, p. 159)

aquifer. Directly opposite the mall is land zoned for a public park but never developed. It provides living space for pavement dwellers and buffalo herders, who store water in plastic containers. A squat grey structure near the edge is a defunct tubewell. A Project manager described the malls' water supply like this:

> Levé: Shopping Malls […] are not our customer[…] They get water from tubewells and water tankers. […] They're *personal* uh [he says this in a voice like Marlon Brando in The Godfather]
> (Personal communication, senior manager, Project offices, Delhi, 21/04/15, fn56)

The malls are heavy groundwater users, and Project staff are aware of this. The loss of revenue potential from such large consumers is perhaps balanced by the lack of additional demand on the Project's total water, which is already in deficit. There is an additional advantage to the project, in that any Project customers in the area that are left on groundwater supply will be those that have refused to take a meter, and therefore a falling water table will only be an incentive for them to take a metered connection with the Operator. The PPP seems designed to avoid conflict with existing high-income groundwater users while reducing use by low-income users, such as households in Hauz Rani and Khirki, who use private tubewells or consume drinking water from illegal bottling plants. At the same time, the PPP project itself was actively working to limit or remove informal water economies by replacing metal pipes with PVC which cannot be drilled to install a provide an illegal pipeline, cutting illegal house connections, installing meters (preventing 'average use billing' as well as commercial resale), and phasing out of tubewells.

Undeveloped park with buffalo herders, pavement dwellers and defunct tubewell (left)
Mall directly opposite (right)

For work in unplanned areas, urban villages, unauthorised colonies, and *jhuggi jhompri* clusters, the Operator also faces obstacles from state agencies. The Operator needs to obtain a No-Objection Certificate from the Urban Development Department before connecting these areas, a fact Project staff were not aware of when they started the contract. So the people from the multinational were bidding on a contract to supply water to a population, unaware that 30-50% of connections were illegal and that many areas of the network would require legal permissions from the government before they would be able to extend service to these areas.

> Levé: Ok, one other thing that I forgot to tell you earlier is that today what is slowing down the project is that today we have some pockets, or colonies, or sub-colonies, which are unauthorised by the UD, I think it's the Urban Department. I think so. So we have some pockets where we should not lay any pipe... and we did it already unfortunately! Because at the beginning we didn't have the information. So in some areas we are not able to go. This is the map of this unauthorised colonies. So we have all the lists and some of them, like [Dakshin Vihar] you were saying, is here, so this one we should not do any works over there except changing PVC pipes.
>
> Researcher: Oh, okay, so if its internal pipes and they're PVC, like people have laid them themselves, you can improve that you can fix that?
>
> Levé: Yes, in this case, yes. So there are different cases even by DJB.
> Personal communication, senior manager (male 45), PPP Offices, Delhi, 21/04/15, fn56

An example of this lack of relationship between the 'on ground' realities, administrative regulations and knowledge is the differing statuses of Khirki Village and Khirki Extension, which come under different MLA constituencies[251]. Most of Khirki village, including Chauhan Bagh, falls under Greater Kailash Constituency, while most of Khirki Extension (and the Saini Mohalla area of the village) is under Malviya Nagar Constituency[252].

[251] Personal communication, PPP manager, Khirki, Delhi, 22/07/15, fn98

[252] http://ceodelhi.gov.in/WriteReadData/AssemblyConstituency/MALVIYA%20NAGAR%20Model%20(1).pdf
http://ceodelhi.gov.in/WriteReadData/AssemblyConstituency/GREATER%20KALASH%20Model%20(1).pdf

> M.S. Sharma: Khirki Extension is unauthorised but it gets water! Khirki Village is authorised but it doesn't get water! Khirki Extension gets water because there is a pipeline running through it. So people have taken connections.
> Researcher: This was before under DJB?
> M.S. Sharma: Some DJB or some MLA.
> (Personal communication, Project PRO (male 45), South Delhi, 21/04/15, fn55)

The Operator is planning to make it harder to tap pipes illegally by using a type of plastic that will crack on impact. During my research, they were doing this already around Chirag Dilli, an old urban village with a population of around 150,000 people[253]. The tubewell water in Chirag Dilli is not potable as, like the water in Hauz Rani and Khirki, it is polluted with sewage. This means that households spend around ₹30 per day on bottled water, while groundwater is only used for washing and cleaning[254]. The move to PVC pipes will also affect people living in *bastis* at Mandir Camp and Pagardi Camp[255], who access water from connections illegally drilled directly into the mains pipes (Pagardi have their own connection and Mandir camp buys from others, possibly Pagardi people)[256]. Another research project has described protests from *basti* residents against the new plastic pipes, and concern from PPP staff (Perczel, 2016, p. 32). On the other hand, remember the young men in Chapter Four who showed their *pradhan* 'the name of god'? They had no problem with water, and the larger and more central *bastis* at Rani Camp and Khanamqila[257] received piped supply free, courtesy of various area MLAs[258].

Long term presence in an area is likely to be the best way to understand these localised modifications; however, the older DJB workers, who would be most likely to have this knowledge, are no longer working for the PPP operator. The project manager said that he had started with as many new staff as possible in order to try and mark a break with practices common in the DJB (such as always agreeing to do work in response to a complaint

[253] Personal communication, senior manager (male 45), PPP Offices, Delhi, 21/04/15, fn56
[254] Personal communication, local resident (male, 30), Chirag Dilli, December 2015, fn35
[255] Names changed
[256] Personal communication, residents at Pagardi Camp, June 2015, fn143; Personal communication, residents at Mandir Camp, July 2015, fn144.
[257] Names changed
[258] Personal communication, young men at Begumpur *basti*, January 2016, fn136; Personal communication, young man at Rani Camp, August 2015, fn141; Personal communication, researcher at Delhi National Law University, 21/06/14, fn142

even if this was unrealistic) and introduce a new work culture[259]. Locating elements of the network, such as junctions, valves and inlets, is a key aspect of the project. I would often meet Project workers in my neighbourhood digging up the road. I met one supervisor staring stoically into a large hole which showed only pipe. His team was trying to locate a valve said to be 'where the Hanuman Temple pipe joins the main pipe', they knew roughly where it was from pressure readings. I asked how they would find it. He said that 'the problem is all the old DJB staff do not work here anymore so no-one knows the system. We just have to ask local people'[260].

Appears to be a private water business in a centrally located *basti* with free municipal supply

An example of the way localised power relations affect water distribution is the role of caste and religion. The interview with Tasleem, above, mentioned that the Hindu unauthorised colony got piped water while the Muslim unauthorised colony did not. The caste of area

[259] Personal communication, PPP Project Manager, 19/09/14, fn6
[260] Personal communication, Khirki Extension, Malviya Nagar, 17/07/15, Hindi, fn97 – cf missing valve

residents is also relevant. Bias in water supply on grounds of religion in urban settings has been described by other researchers (e.g. N. Anand, 2012; Contractor, 2012). Published work on caste in urban water provision is rare; however, some of my interviews suggest it is a factor.

> M.S. Sharma: This caste system was there before. In a [rural] village different, what is the word [I think he wants *biradari* 'communities'] would live in different areas. There would be *pandits* [Brahmins, the highest caste] and others, shopkeepers and the lower castes, maybe leather workers. The well would be in the *pandit* area and the lower castes would not be allowed near it [laughs – meaning this is silly]. It is still like that. Only now [in urban areas] instead of the well, it is the line [pipe]! If you try to touch it they will say "don't touch my line". They will want the line to go to their community only and not to give water to the other community.
>
> Me: So you would need all different lines for different communities?
>
> M.S. Sharma: That is there already, they already have from before. You won't know, because people whose water is good won't say, but people whose water is bad will say 'they are getting water, they have a line'
> (Personal communication, Project PRO, South Delhi, 21/04/15, fn55)

(left) Sub-contracted project workers, installing pipes. The tubewell in the top left corner has been turned into a private garden
(right) Project staff installing a new valve

In the area of the South Delhi urban village in the Project zone, where I stayed for 12 months, 'most people' are lower caste Dalits. A resident describes it to me as 'Valmikis and Jatavs mixed. All sorts of SC [Scheduled Castes] are there'. Dalit leader, Dr. B. R.

Ambedkar's birthday is celebrated with a community organised free lunch[261]. This area receives water from tubewells. However, the other side of the village where dominant caste (Chauhan) people live, is connected to the piped network[262]. People in other parts of the city knew of the dominant caste[263]. Remember the 'lost' valve mentioned earlier? Residents from this area were further upset, as a section of the neighbouring urban village belonging the dominant caste in the village, had been receiving water for some time and were having their pipes re-laid at the MLAs expense; a resident from this village volunteers with the MLA's political party and runs the Aadhar Card Centre for the area[264]. Tension between the lower- and upper-caste sides of the village have been documented by other researchers in the context of land dispute. The 'plumbers house' mentioned below also happens to be located next to the tubewell, which has been turned into a private garden (pictured above, Figure 35).

> It was only later we realized the real reason(s) why they wanted the plumber's house removed from there. This had to do with caste relations within the village. The land in question fell within the boundaries of the Saini Mohalla, and upper-class enclave of the village. The plumber was a man who belonged to the Jatav caste, a lower caste, and there had been an ongoing feud between him and his neighbours (J. Chatterjee, 2015, p. 25)

Communications, street and online: (left) rare example of project sign describing work taking place; (right) project website

[261] Personal communication, resident and Ambedkar Jayanti organiser, urban village, South Delhi, 14/04/15, fn53
[262] Personal communication, Juli Perczel, researcher, London 25/08/16, fn140
[263] Village is described as 'Rajput', personal communication, real estate dealer, (male, 35), Sangam Vihar, 06/02/15, fn17. Chauhans are a Rajput caste.
[264] Personal communication, Juli Perczel, researcher, London 25/08/16, fn140

COMMUNICATIONS

> 'At the MLAs office, complaints are the normal way anything gets done!'[265]

It seems that generally, communication with residents is an area where the PPP has so far struggled. Some interviewees noted that the MNC is well known to be an organisation that is strong in engineering but not so much in soft skills like communications - and that the Malviya Nagar Project is an example of this.[266] Interestingly, the initial pre-project report remarked on the 'limited confidence in the technical feasibility and financial viability of implementing 24/7 water supplies in Delhi amongst stakeholders because of lack of communication'.

> DJB shall take initiative to communicate aggressively the advantage of projects to stakeholders. It is very important because the short-term disadvantages of project will be experienced ahead of long-term advantages of project. The implementation strategy should be design and implemented to avoid the situation or minimise the inconvenience to stakeholders during initial rehabilitation period based on past experiences in similar projects (Nagpur, Karnataka etc).
> (DRA Consultants Pvt. Ltd. & Shah Technical Consultants Pvt. Ltd., 2011b, p. 15)

Sadly, very few of the RWA members I spoke to in the PPP zone (Khirki DDA Flats, Hauz Rani Village, Hauz Rani Ext and Khirki Ext) had received formal communication from the Project. The president of Khirki Village RWA had received a letter. Although the Project Public Relations Officer interacts with the established hierarchy of elected representatives at state and city level and the local RWAs and *pradhans*, constructive engagement with residents through these channels has been limited.[267]. At the same time, as the quote below illustrates, customer complaints are an essential channel of information for the project (cf Chapter Four, page 110).

> Researcher: On a regular daily basis, weekly basis, how do you come to know about water, about the things that are happening in the project?
>
> Levé: To know what is happening? Today what the best thing that we do know what is happening is that [1 second pause] we put in place a 'call centre' [he says it

[265] Personal communication, Juli Perczel, researcher, London 25/08/16, fn140
[266] Personal communication, PPP staff, 9/08/15, fn110
[267] Personal communication, PPP PRO, South Delhi, 21/04/15, fn55

> hesitantly, like it is a strange and unusual thing]. Ok, since the beginning it was by contract, we have to put a call centre so all the customers in the project area, if they have a problem can call this number and after that we collect complaints, and after that this complaint comes to all the team and we er… [1 second pause] attend and we resolve the complaints. So it's why we know what is going on in the project area, is thanks to the complaints of these customer. So if there is problem of er no water, problem of er high bills, problems of er contamination, water contamination, we know it from the customers and of course also in operation ah, we do some er, er, monitoring of what is going on, so we go to see if the T points are working, we go on the field to take some water samples for water quality, er, we er [1 second pause] go on site to take pressure... [1 second pause] we do some also flow measurements so we are monitoring anyway, we have team to do that. (Personal communication, senior manager, PPP offices, Delhi, 21/04/15, fn56)

Other Malviya Nagar Project staff described the process for managing complaints as being designed with lots of processes 'so that if anyone asks, solid process [sic] exists to handle complaints', 'but *solving* complaints is not really an objective'[268]. Indeed, increased efficiency in resolving complaints is a contractually stipulated outcome for the Operator – however the contractual schedules only specify *recording of response* to complaints, and 'time and date of resolution', further 'no water' and 'poor quality of water' are 'allowable exceptions' (Delhi Jal Board, 2012, p. 1995).

Ethnographic research on local politicians describes their role in placing pressure on various public and private agencies to help individual constituents (Berenschot, 2013; Perczel, 2016). Anand observes that 'In their effort to cope with [customers'] demands, [engineers] often reallocate water from areas of low political pressure to areas of higher pressure, constantly making adjustments until people stop shouting' (N. Anand, 2011, p. 553). Remember how the Project PRO had attributed illegal tapping of the pipes to 'some DJB or some MLA' (page 143 above)? The precedent for interventions from local representatives, in order to secure waivers and modifications for select groups of residents, has been a culture clash with the PPP staff, which has led to some tensions. At the same time, more than one European employees of the PPP raise the issue of 'Indian work culture', this being a tendency to avoid conflict by agreeing to all requests, regardless of practicality, possibility

[268] Personal communication, PPP staff, South Delhi, 10/07/15, fn94

or intention to deliver[269]. This was cited as one of the main reasons for replacing original DJB staff with new hires. Difficulty in hiring adequately qualified staff was also mentioned.

Latent hostility from residents, localised political dynamics, the legal framework and the material ('under-ground') complexity have been a steep learning curve for Project staff[270]. During my research period at least two significant members of Project staff left, citing unrealistic demands and excessive levels of stress in the job (at time of writing a third has returned to France). A number of respondents noted that PPP staff were 'in the front line', and were often 'chased away' by residents who did not want them to disrupt the existing water supply network by digging in their area. A PPP manager described the 'mob' of angry protestors that disrupted work in the offices during one of my visits as 'motivated by politicians'[271].

> '[Distrust of the project] does affect us at street level, we [in the offices] are the second line of fire. People will harass street level staff - will not let them into area because they do not want them to mess around with the water.'
> (Personal communication, senior manager, PPP offices, Delhi, 19/09/14, fn6)

> 'One thing is that they guys doing the street works, who are anyway from [the Local Partner] or [their] sub-contractor, are constantly approached by people and have to 'pitch the project' to them. They are not very good at this and this causes tensions. They could easily put signs up saying this work is going on, this is what it will be and how long for and it is for a project to do x, y, z. But they don't.
> (Personal communication, Project staff, Delhi, 23/06/15, fn90)

> "Yes of course, sometimes […] PWD [Public Works Department] people are reluctant to let us work because […] we didn't restore the roads before, for the part that we committed to dig and restore, we didn't do it, so they say "Ok why we will allow you to have a new permit to excavate again if you didn't do work totally before?" […] and some people are more reluctant because they are the resp- [cuts himself off], they are the y'know the boss of the area so they want to show their power. […] It's the project, you know it's always like this. […] I don't know about the staffing for the roads repairs how that contract was awarded. Maybe it was someone they knew earlier and he applied. I don't know. […] The budget for roads, even though it is half of the overall budget is very tight. It is costing more

[269] Similarly multi-tasking customer service representatives and 'assertive queueing' are a cultural norm in India, whereas they can cause anxiety in other contexts (Gandhi, 2013)
[270] Personal communication, PPP staff, 19/09/14, fn6; 21/04/15, fn56
[271] Personal communication, PPP manager, Delhi, 19/09/14, fn6

> than we thought so we are not able to do them to the standard that [Public Works Department] wants."
> (Personal communication, senior manager, PPP Offices, 21/04/15, fn56)

While the PPP model appears intended to insulate infrastructure development and services from political risk, it becomes apparent in this case, that it is not impervious to pressures from democratic representatives, both at the city and ward level. It was explained that because of the frequency of requests for expedited work as well as unexpected delays, project managers were required to be extremely flexible and constantly changing the work schedule…

> "it's very challenging because you have a lot of parameters that are going inside your planning y'know, plus the pressure, the politician that come to us more, the most um… [pause] pushing politician he will ask us to put priority of works in his area, to show up etc so it's also a parameter that come on the way in order to plan the global cap-ex so it's you have to manage all the interests of everybody"
> (Personal communication, senior manager, PPP offices, Delhi, 21/04/15, fn53)

The Project must manage complicated interactions with both state agencies, elected representatives and consumers. A key role of community representatives is to lobby service providers (or more powerful representatives) for better delivery to their constituencies. This kind of pressure from representatives was cited a number of times by PPP staff as changing the planning and programme of works. Intervention by political representatives was both described by interviewees and witnessed by me on a number of occasions. As the DJB and the Operator are in frequent communication, interviewees stated that MLAs would be able to 'give orders' to the DJB who would then pass them on to the Operator. Although the relationship between the Operator and the DJB was governed by contract this was described as 'shady' and the contract itself as something the employees did not have easy access to as it was 'quite confidential'[272].

Such is the concern to be seen to be doing work, that at one time when the PPP operator in Malviya Nagar was replacing the pipes in a road adjoining Khirki Village, the MLA for the area had pipes on the opposite side of the road re-laid out of his own funds so that the

[272] Personal communication, PPP staff, Delhi, 9/08/15, fn110

village would not feel that others were being favoured over them[273]. The two photos below ('Sign wars') were taken at the same time, the two signs are facing each other. On the left: PPP works attempt to pump leaking sewer water from pipe relaying site. On the right: on the opposite side of the street, pipe relaying funded by the MLA for a privileged section of the urban village. There is a stark difference in the tone and content of the signs. The MLA's is much more conversational and includes an email and phone number.

Sign Wars

The discursive use of the project, however, has been increasing and changing. As of 2017, the DJB has started to publicise the Malviya Nagar project as a way to save water for the city (Alavi, 2017; Delhi Jal Board, 2017). In March 2017, the DJB recently published a video on their Facebook page explaining the 24/7 pilot in Geetanjali and describing it as an initiative to save the city and consumers water and money. The video ends by stating that 'the successful model is now ready to be implemented in other areas, today Malviya Nagar constituency, tomorrow Delhi state, in the future, urban areas of the whole country' (Delhi Jal Board, 2017 [my translation]). About a month later, the DJB CEO published an article, which described 'market environmentalism' as influential, but unpopular and consequently unsuccessful due to its neglect of social equity. Acknowledging that water 'has largely remained the Achilles heel for the private sector in India', the article closes by noting the importance of 'the country's reality' and that the 'success of water projects almost entirely depends on the sensitisation and adoption of the project by all stakeholders' (Keshav

[273] Cf 'stealing work' story on competition for political credit from AAP worker in *Chapter Four*

Chandra, 2017). The article reinforces the idea in the DJB promotional video that the PPP project can save water for the city.

> Critics of PPP projects of Delhi must understand that the cost of projects to save water in the present system shouldn't be compared to the current rate of production of water. Availability of additional water in Delhi is only possible at enormous financial and environmental costs, after setting up three dams—Renuka, Lakhvar Vyasi and Kishau—on the upper tributaries of Yamuna. The cost of water saved through PPP projects is minuscule as compared to water augmented through these dams (Keshav Chandra, 2017; for the economic inefficiency of large dams see Ansar et al., 2014).

In May, the MLA for Malviya Nagar has published a video showing him in a meeting with private sector consultants where he is briefing them in an attempt to initiate continuous pressure flow (as in the PPP) for his whole constituency (Adv. Somnath Bharti, 2017). In this way, the PPP has influenced aspirations for the wider public sector supply (albeit within one constituency). A few days later, the AAP government announced that the PPP's 24/7 pilot is now being extended to Navjeevan Vihar, a neighbouring area of similar size within the PPP zone (Alavi, 2017). It appears that despite a challenging start, the PPP initiative in South Delhi has been able to attract support from the DJB and AAP politicians and is now set to spread further.

CONCLUSIONS

As in *Chapter Four*, international agencies and norms can be seen to have had an influence over Delhi's water supply arrangements and policy. Numerous scholars have noticed similar influence (e.g. Gilbert, 2007b; Goldman, 2007). Unlike the standard narrative of powerful international organisations exploiting the local public sector, in this case, the Multinational partner in the PPP project appears to have been insufficiently diligent before accepting the tender resulting in an unrealistically low bid. In this case, the Operator appears unable to re-negotiate and will be forced to honour its commitments. In fact, the tariff increases implemented before the projects started were cited as a factor in the defeat of the incumbent government and the rise of the AAP, headed by anti-privatisation campaigner,

Kejriwal. If so, this would be a case of popular dissatisfaction leading to a change of government rather than contract renegotiation.

This private sector reform projects appear to have underestimated the complexity of the physical network and the resistance of local populations. Unlike in OECD countries, the water network has been physically modified extensively. This includes both private infrastructures (mentioned in Chapter Four) installed at consumer end such as leaky pipes, overflowing tanks, and malfunctioning meters, and modified and self-laid networks in unauthorised areas (such as those in Chapters Four and Five). These personalised infrastructures cause problems with flows of both water and data. Further, residents are now quite protective of these arrangements and resent, and intervene physically and politically, to stop any attempt to re-engineer them. Delhi is more planned, and much wealthier, than most Indian cities. However, even in this environment, the level of complexity of the physical water networks is a formidable challenge and the project has made slower progress than anticipated. Three years in, this work is still ongoing, with even the water coming in to zone not completely understood. Privatisation, reform, and network rehabilitation projects in this context are clearly very different propositions to experiences in places where the network is already complete and known to the operator (N. Anand, 2015, 2017, Björkman, 2011, 2015), and this blurring of public and private (or formal and informal) infrastructures again makes privatisation more complicated (Briscoe & Malik, 2006, p. 57; Burt & Ray, 2014; Button, 2016). As the project profit structure and the added value of international expertise is dependent on accurately being able to map the network this raises serious questions over viability.

In the neighbourhood of the PPP pilot, the network has become informally modified under the influence of powerful households, even in planned areas. As many of the original DJB staff for the zone were replaced, knowledge of the network is limited and workers had to ask local residents in the hope of finding important components buried underground. In these ways, the Project not only seeks to alter the distribution of water; information is a key area of work. Information that was previously unavailable or highly decentralised with different agency workers and private households is to be, according to Project objectives, collected and centralised with the Operator (cf Mitchell, 2002). If completed, this would

have the effect of relocating information to a centralised agency; if not 'the state', then one with a contractual relationship to them. It would also remove information on the water network from more locally embedded individuals.

The PPP project studied appears to be part of a 'second wave' of private sector involvement in water supply (Smith, 2004). Earlier private sector initiatives were observed to 'cherry pick' only the most profitable sites for involvement (Bakker, 2010; Budds & McGranahan, 2003). While Delhi is very wealthy in comparison to the India average, and two of three Delhi PPP zones include wealthy parts of Delhi, the PPP zones do not only include high-income areas. The Delhi PPP zone studied is a deliberately diverse mix of areas, including unplanned as well as very wealthy areas, to 'test' the operator, and suggests and willingness on the part of the government and the private sector to learn how to work in these environments. Additionally, there is a project objective for the operator to extend service to 100% of residents in the project zone, rather than cut-back to higher paying areas. This element of the project is similar to Gopakumar's findings in Bengaluru, where he regards a PPP intention to include slum settlements as territorialisation, intending to integrate the archipelagos of service provision into a larger island (Gopakumar, 2014, p. 404). This model of mixed-income pilot zones was also employed in the Hubli-Dharwad PPP in Karnataka (Burt & Ray, 2014, p. 112). However, in Delhi, unlike the Hubli-Dharwad pilot zones, the PPP zones are not easily hydraulically isolated from the rest of the water network. It should also be noted, however, that while 100% connection is a stated objective of the project, the Operator is contractually obliged to extend connections only to areas that the DJB has approved, and there is no stipulation for the percentage of population to be served in the schedule of contractual financial penalties. As the project is currently incomplete, the effects on equitable and accountable water distribution are unknown.

Although a focus on higher income areas is not specified, pragmatically this has been the case with project 'priorities' in order 'to make progress', with wealthy areas, easier to hydraulically isolate, chosen as sites for continuous supply and low-income areas chosen as targets for NRW reduction through closing unauthorised connections. While the Project was heavily oriented towards demonstrating 24/7 continuous water supply, this was not necessarily cost-effective or appreciated by consumers. Although attempts to develop 24/7

water were successful in meeting technical difficulties, the initiative faced obstacles after providing continuous pressure supply due to a combination of leakage and inefficiency in private household networks (after the meter) and patterns of water use from powerful wealthy consumers unwilling to change their behaviours. At time of research, as these influential people 'did not notice the difference' the Project had reduced the hours of continuous supply in two pilot areas in response to consumer complaints. My findings here are similar to a much larger survey conducted in South India which also found that informalities continued after continuous supply was implemented (Burt & Ray, 2014).

The design of the project also allows government to retain control of tariffs. Water tariffs for Delhi were set prior to project implementation with built-in over-time rises. Water pricing remains under control of the Delhi government. The AAP government's free 600kl water policy is a later layer of policy change that the Project must incorporate. Combined with a progressive ruling party in the city, this marks a departure from earlier privatisation attempts as affordability concerns are met by free lifeline water in Delhi. As the PPP doesn't set prices, if the government can design subsidies effectively it should enable extension of the network to unserved areas and reduce poor people's bills. In this case, the particularly history of popular protest against privatisation, combined with the presence of vocal and powerful residents and a populist ruling party, has given rise to a tightly controlled PPP model which could give more redistributive outcomes to the earlier unsuccessful and unpopular privatisations initiatives. However, these conditions are exceptional and this model would be hard to transfer to the rest of the country (in the absence of popular movements, political support, investor interest, informed and active civil society groups, possibility of financially viable return, etc).

In the more mundane areas where a majority of the population lives, municipal water supply is either low-quality ground water, or accessed through the intercessions and discretionary spending of political representatives, or tapped from municipal pipes illegally. Drinking water for those who can afford it is from private suppliers of 20 litre jars (as described in Chapter Five). Given the resistance to introducing metering in these areas, attempts to realise user charges cause an issue for the financial viability of projects like this. The Project objective of reducing Non-Revenue Water (NRW) is being attempted by cutting

off illegal connections and requiring all customers to use a meter. In this case, it seems that those who do not register their connections and accept meters will be left using groundwater. This is likely to primarily affect low income households in unauthorised settlements who cannot afford a meter, do not have documents or money for bribes to obtain a legal connection, and have limited budgets. Here, as in *Chapter Five*, we see again groundwater functioning as a supplement to network supply. However, while for the DJB in Sangam Vihar it mitigates the effects of uneven and unreliable supply, for the Project zone it cushions the impacts of *increased* efficiency. Groundwater has an additional function in the Project zone, which is to top-up bulk water supply. Bulk water supplied to the zone (from a PPP WTP run by the same MNC) is insufficient for the population. The shortfall is likely to lead to continued reliance on groundwater. As treated water is insufficient for the whole population, if some (low income and minority group) consumers refuse to accept meters and are left reliant on groundwater, as suggested above, it will be advantageous to the project's overall water and financial balance. Heavy bulk water consumers, like the large shopping malls in the zone, also rely on private groundwater and do not use network supply. Thus there is a risk of leaving low-income consumers reliant on poor quality groundwater which is also being rapidly depleted by large private sector users and wealthy households.

CHAPTER 7. CONCLUSIONS

Urban water in India, particularly groundwater use, is a critically important area of future concern, largely neglected by policy and social science research. This thesis has attempted to contribute a rich empirical analysis of urban water in Delhi, with particular attention to informality, groundwater and reforms. I use informal infrastructures as a focus to follow the neat models of reform initiatives into the murky epistemological and ethical complexity of material and social realities. The thesis makes several original research contributions. Empirically, I add to work on the informal political economy of urban groundwater use, 'second wave' private sector water management through Public-Private Partnerships (PPPs), and the relationships between urban groundwater and reforms. The thesis analyses of a range of common features of urban water in India – informal groundwater use, decentralised infrastructures (such as tubewells and tankers), and private sector network management – and their relation to urban governance and politics. In this respect I build on empirical lacunae in earlier research on urban water, and urban water reforms, in India. I also contribute to research on governance and urban services in unauthorised colonies and urban villages. Conceptually, I introduce the idea of 'informal infrastructures' as a theoretical frame and methodological approach which connects my fieldwork across sites and scales. Practically, my project studies how the interactions of reform initiatives with the complexities of the existing water governance environment shape the possibilities for better water access and management.

This concluding chapter is structured in four sections addressing the themes of the thesis: informality; governance; groundwater; reforms. I close with indications for future work.

INFORMALITY

The initial broad research question I asked was: '*How is water governed in Delhi?*', and more specifically, '*What are the politics of Delhi's water, and the hydraulics of Delhi politics?*' Gaps in the academic literature led to three main sub-questions:

1. *How is public water supply governed?*

2. *What role does groundwater play, and why?*
3. *How do water reform initiatives relate to groundwater and government supply?*

The idea of *informal infrastructures* or *infrastructural informality* connects my empirical research across different sites and scales. Bringing ideas from the literature on informality and infrastructures together under this framing offers modifications to the ways that 'informality' and 'infrastructures' are often used.

I suggest that both informality and infrastructures should be understood relationally: as terms which must be defined in context. Thus informal infrastructures include both urban services at a distance from official regulation (such as private water tankers, private tubewells and illegal bottled water factories) and *informalised* official infrastructures (such as diverted public water tankers, captured government tubewells and modifications to the official piped network).

My suggestion is that research on infrastructure can contribute to work on informality by introducing different dynamics to work on spatial planning and livelihoods. Water in particular forces us to think about space through flows, mobility and networks rather than static territories. Close studies of infrastructure foreground complex material and technical realities which may be overlooked by more theoretically oriented urban scholarship.

My research on informal groundwater use and water reform projects extends a focus on the political effects of materialities beyond earlier work on piped water supply (N. Anand, 2017; Björkman, 2015). Material aspects of the informal (and informalised) water infrastructures I study, such as tubewell depth, pump size, tanker capacity, pipe gradient and valve locations, have very real impacts on to ability access water. These material characteristics of informal infrastructures shape the possibilities for further informal influence, political change or reform.

While informality is often thought of as filling 'gaps in state services', many informal practices, such as urban service infrastructures, are also imbricated with state actors and agencies (e.g. Kacker & Joshi, 2016). Perhaps due to the different levels of modesty and

scope within the respective disciplinary lineages of engineering and economics, historical and ethnographic studies of infrastructure tend to have a more mature treatment of 'incompleteness' than work on informality. Consequently, detailed empirical studies of infrastructural systems challenge uncritical uses of informality predicated on an implicit dualism and reification of the state that would be rejected by many state theorists (e.g. Abrams, 2006; Brenner, 2004; Jessop, 2008).

The informal infrastructures of interpersonal arrangement that often mediate access to urban services (administratively or physically), that others have called 'people as infrastructure', 'zero degree' or 'invisible' infrastructures are an additional area of my research (De Boeck & Plissart, 2004, p. 235; Simone, 2004). Personalisation and brokerage illustrate the porous boundaries of statehood. At the same time, the 'absent presence' of infrastructure in areas of Delhi like Sangam Vihar/Deoli allows alternative urban service formations to arise (Boeck & Baloji, 2016). In this way I use 'informality as a method' to direct attention towards the contingent, assembled and enacted nature of infrastructures along the spectrum of official governance and predictability.

This thesis makes an empirical contribution to infrastructure studies by focussing on informality in infrastructures, small technologies, and the global south. Govind Gopakumar has done excellent analysis of the progress of reforms among Indian water utilities using an actor-network view of the state and socio-technical understanding of change (Gopakumar, 2011). Similarly, Vicky Walters and Vandana Asthana have analysed policy processes at government level (Asthana 2009, Walters 2013). I seek to add to this work by introducing informal infrastructures and processes within changing urban water systems.

When thinking of reform initiatives, infrastructural informality is a central, and challenging, issue, yet little mentioned and subsumed under technical components (such as 'non-revenue water') without the understandings of statehood, politics and social dynamics which an informality lens connotes. My empirical work shows that materiality structures and mediates the opportunities for informalities, politics and reform among various forms of water infrastructure. Some implementation of political agendas through technical decisions ('technopolitics') is evident, for example in tubewell or booster pump siting or

water tariff structures. However, water supply is as much a product of human as technical relationships, particularly where the infrastructures are more provisional. Here there is a far more overt politics of water access; tubewells are captured by strongmen, water tankers are diverted by side payments, and administrative processes are waived – even at the level of the entire city – for political expedience. The possibilities for action over various forms of water distribution are shaped, but not determined by, the materialities of those forms.

Conceptually, I suggest that attention to informality can contribute to research on infrastructure studies, by emphasising the social, processual and relational elements of large technical systems. Understanding infrastructures as 'performative' prompts a shift towards viewing them as malleable, contingent and dynamic networks or 'assemblages'. Thinking through informality forces us to ask what is outside 'official' governance (economy, politics, infrastructure), when, and how? By virtue of its knowing relationship towards these boundaries, informality is inherently tied up with questions of power, to evade as much as enforce. Thinking about informality leads us to question the boundaries of concepts such as 'the state', 'the economy', 'politics' and 'infrastructure' and the performative 'boundary work' necessary to produce these entities as coherent effects (Star & Bowker, 2007; Björkman, 2014; Mitchell, 2006, 2008).

GOVERNANCE

The governance of Delhi's government water supply, provided by the Delhi Jal Board (DJB) is at first glance directed by State Assembly policy, the DJB Act, and decisions of the DJB CEO and Board of Directors. Written policy differentiates between communities on the basis of land tenure and formalises bias – in the amount and qualities and methods of water distribution – in favour of wealthy (largely upper caste, largely Hindu) households. Put another way, as responsibility for water provision falls primarily on female members of the household, biased allocation has a negative effect on women from less well-off, lower caste and minority religious groups. This formally 'differentiated' aspect of Delhi's water provision is unlike a homogenous network model (Bakker, 2003; Kooy & Bakker, 2015) in that a simple metric of connected or not does little to explain water supply patterns among neighbourhoods. Consequently, my work supports the proposal by others to move beyond

a formal-informal binary, to more specific concepts (Gandhi, 2012; McFarlane, 2012; Truelove, 2016).

To illustrate: the DJB network of components (pipes, booster stations, treatment plants, etc) is represented at varying levels of accuracy. However, the 'quality' of this network is unmapped. Maps may record the *historical* location of pipes, but the timings and qualities of water flow are not mapped. These temporal and qualitative aspects of infrastructure are key, unobserved dimensions (Marie-Hélène Zérah, 1998). As others have also shown, even within formal areas which should be accorded the same level of supply, discrepancies exist (Biswas, 2015). Aside from the temporal changes and inaccuracies in the mapping, large areas of the city where pipes do not *officially* run are simply blank on the official maps. These limitations of knowledge and physical control over water inputs, quality and distribution mean that at the delivery end of the system, outputs for households and communities are strongly influenced by the actions of locally powerful individuals, including elected representatives, government officials and community leaders, and household level private infrastructures such as pumps, tanks and filters. The boundary between official and unofficial practices and infrastructures in Delhi's government water supply system is porous. We can understand Delhi's 'formal' water supply system, the DJB piped network, as 'informalised' along a number of dimensions. Additionally, the private, household and community water supply arrangements often used to informally supplement inadequate government supply are highly varied and site- and process- specific.

Informal influence over water supply in Delhi, while the varied and differentiated outcome of a complex blend of agencies and material factors, maintains overall the historic pattern of higher quality supply for upper class residents as well as pockets of better access for other politically well-connected communities. Water supply in contemporary Delhi is far more complex than during Mughal rule and patterns of inequality have changed, through the layering of processes during colonial, post-independence and post-liberalisation eras. Today, influential groups from historically dominant castes, both regionally and locally, newly affluent groups, and a relatively small number of marginalised communities with political access are able to capture elements of India's liberalised developmental state. Despite concern over privatisation in Delhi, the results of the actually existing combination of

privilege and patronage in Delhi's water supply appear *less* progressive than the attempts to rationalise and commercialise the city water supply through the involvement of multinational companies.

In fact, the relatively high level of informality in DJB protects this state agency from efficiency drives, whether in the form of partial external take-overs (as in the Delhi Public-Private Partnerships) or internal commercialisation reforms. DJB reforms to water and revenue zones in 2003 intended to improve distributional equity, appear to have *decreased* their ability to understand the movement of water across the city. This example is indicative to me of the class bias of informal influence which can allow reforms to be subverted to undermine their intended objects. For example, in Malviya Nagar, informality in the water supply serves to protect the state water supplier by making it hard for the private sector to function. The fragmentation of governance structures through PPPs should be balanced against what might considered an earlier 'privatisation'; the actually existing fragmentation of governance through informality and discretion of politicians and agency workers[i]. This localised and private knowledge is integral to the functioning of the public water network, at the same time as it impedes its overall efficiency.

The bias towards central, wealthier, and politically better-connected areas of the city in distribution of government water leaves other areas consuming large amounts of private informal groundwater. The Delhi government policy prior to 2016 of not authorising private water connections to urbanised areas outside the city masterplan (unauthorised colonies, urban villages, slums, resettlement areas, JJ clusters) is a deliberate fragmentation of water governance structures which knowingly relegates informal and predominantly lower-income neighbourhoods to informal, ad-hoc urban service solutions. The common understanding is that leaving areas reliant on informal arrangements maintains political influence through 'vote bank politics'. My research complicates this picture. In Sangam Vihar, a key political constituency, albeit one in which only a minority of voters are registered (and therefore not a conventional 'vote bank'), informal water management has been used to support party politics financially but has been a risky and unsustainable strategy electorally.

[i] The South African social movement *Abahlali baseMjondolo* has long used 'privatisation' in this context.

The Malviya Nagar case adds further detail. In the resettlement area of Begumpur, residents have been provided network water through political discretion from various political party intermediaries. However, informal water is used in much higher amounts in surrounding wealthy areas through a combination of non-metered billing, leakage and 'after the meter' waste in the household network. While informal access to water is highly valued in low income communities, the amounts used are much less and not a significant concern for the PPP project. In areas of Malviya Nagar, such as the low-income 'informally urbanised' Muslim urban village and unauthorised extensions of Hauz Rani, where the population dependent on informal water management is not significant electorally or financially, groundwater use may be viewed as a residual 'do-it-yourself' coping strategy at low cost to government agencies.

GROUNDWATER

Delhi's declining water table demonstrates the importance of groundwater in the city. Groundwater is clearly essential to many water suppliers and household users in Delhi. It contributes around 10 percent of government water, particularly in areas outside of formal land-use planning. Much larger quantities are likely to be consumed in unofficial, and often illegal, groundwater use by private households and commercial enterprises. Given the limited and unreliable timings and quality of government supply, this informal use provides an essential coping strategy for households and communities. In so doing it dilutes public anger and reduces political pressure on government to provide a more efficient and equitable service. However, groundwater is a slippery political ally. As Anand notes, in the context of Mumbai, the materiality of water 'exceeds politics and destabilizes its distribution regimes' (N. Anand, 2011). Dependence on groundwater sources for political funding and local influence renders political parties vulnerable to increasingly adverse environmental conditions and embroils them in the murky local political ecologies of groundwater control.

Informal groundwater use is a rivalrous use of a common pool resource, favouring those able to afford deeper wells and larger pumps. A consideration of these 'small technologies'

extensively used in the global south, such as tubewells and tankers, provides a different perspective from piped water networks more commonly studied in previous research on urban water in India. Discreet and discrete, the technologies of tubewells, tankers and water filters allow interventions to supplement state water supply (in quantity or quality) by private actors for self-provision or profit. The anonymous nature of these technologies, of which the tubewell is the most significant, leads to a classic tragedy of the commons in which as the common pool resource is underground and withdrawals are not observed, except in aggregate, there are no incentives for restraint or sanctions for overuse. The inadequacies of government water supply lead to a double ecological impact: an increasing bulk water supply from the hydrological hinterland and a reduction in groundwater in the urban region. The colonial legacy of groundwater as the private property of the landowner further facilitates aquifer degradation. Aquifer depletion reduces the quality of water available. As groundwater levels fall, the waterbodies and streams across Delhi become drier, increasing the relative level of pollution. The informal infrastructures of groundwater use, whether coping or profit strategy, displace the costs of inadequate water supply onto the wider environment. The historically dominant trend in the development of Delhi's water network since installation of a piped network under British rule has been to increase bulk water supply, disregarding distribution and efficiency. This has resulted in Delhi depending on water from hundreds of kilometres away. Groundwater cannot be relied on as an 'off-balance sheet' solution to fill the gaps in unreliable and biased network provision. Surface water and groundwater must be recognised as connected, at the urban and hydrological scale.

Just as the ability of rural India to survive on limited water provision allows Delhi to capture excessive quantities of water for the city's wealthy, informal groundwater use in areas like Sangam Vihar allows the government water supplier to provide minimal amounts of water enabling it to avoid redeploying water from other areas. The water supply modes used in Sangam Vihar allow politicians and officials to maintain personal relationships with water users for political and financial benefit. The informal sector in Sangam Vihar, rather than being created through government action (as in DJB informality) appears to be partially outside of government control.

The manifest complexity of water supply modes in Delhi problematises a simple public-private distinction as well as the concept of 'water governance'. In this context, what we are seeing is rarely coordination among multiple actors, as implied in the concept of governance, but market competition supported by social power. Karen Bakker has described the contemporary challenges for water supply as a case not of state failure or market failure, but 'governance failure', which appears to restate a normative, rather than critical, understanding of governance.

The governance of water in Delhi could in fact be seen as an unstable, and ultimately temporary, 'success' for the ruling party and city bureaucracy. If groundwater was unavailable in Delhi, either bulk water supply would have to be increased or water would need to be redistributed across the network. The high costs, political challenges and long lead times required to increase bulk water suggest redistribution as a solution, although until recently increasing bulk supply has been preferred. In this context forcing users to rely on supplementary groundwater allowed the city's politicians and water board to avoid having to confront the political challenge of redistributing water from powerful wealthy consumers to poor marginalised populations. While the possibility of groundwater use reduces the public dissatisfaction resulting from inadequate water access, this is an unsatisfactory compromise for everyone which is maintained to avoid the costs of change.

Bakker's move beyond an 'unhelpful' public-private binary has also led to interest in the role of smaller providers in water supply. Vinay Gidwani, in a reply to Bakker, suggests that decentralised non-network infrastructure through small-scale private sector actors might offer solutions that are not possible from the international private sector in water.

> How should we understand the 'private'? […] Are all forms of privatization equally troubling or equally unequal? Can some forms of privatization—say, small-scale private providers in urban informal economies—provide interim solutions to the urban water crisis? (Gidwani, 2015, p. 1)

I respond to this question of different forms of privatisation in my discussion of personalisation of governance above, and the Delhi PPP project below. The small-scale private providers I have observed in my research, and decentralised infrastructures more

broadly, state or private, are not empowering for users: they are problematic in a number of ways. The regular, recognised contractual arrangements for government tubewells and tankers are not the 'co-production' of Joshi and Moore, but 'co-production' as Ahlers et al suggest we redefine it: unequal, contested and exploitative (Ahlers et al., 2014; A. Joshi & Moore, 2004). The private sector alternatives, which, as informal infrastructures functioning outside of regulation, have a relationship with state agencies that is tacit at best, are more opaque and less accountable.

My research shows that criminal networks in water provision are a substantive issue, contrary to the scepticism expressed by some researchers (e.g. Björkman, 2015, pp. 180–189; Graham et al., 2013). For example, Björkman describes talk of corruption in tanker delivery of municipal water in Mumbai as more symptomatic of the complex public system and widespread use of brokers and side-payments than organised illegal water businesses. However, Mumbai's water politics primarily revolves around piped supply. In Delhi, groundwater use is extensive, which allows the development of far more substantial illegal water businesses independent from the public network. Of course, there is also corruption in government water supply, and they are, sometimes, connected (see Chapter Six, page 165 ff.). Numerous respondents have described private water operators as 'mafia' operating outside the law to researchers and journalists (Rai, 2012; Sheik, Banda, et al., 2015, p. 5), although in a south Asian context 'mafia' connotes assertive enterprise with a relaxed attitude towards regulation and use of social connections rather than the crime families depicted in western popular culture (see e.g. Chapter Six, page 141, 145 above). As noted earlier, the use of 'mafia' as a criminalising term often directed at Sangam Vihar revives the British registration of pastoral Gujjar people as a 'criminal tribe', 'addicted to cattle-lifting' (Machonachie, 1884, p. 85)[i]. In addition to being used as a conveniently loose accusation (see page 241 below), the term is broadly used to refer to a range of varying informal and illegal activities: government tubewell capture; private tubewell networks; the connections needed for reliable tanker delivery; illegal private sale of government tanker water; tips and facilitation payments for tanker delivery; illegal bottled water factories using

[i] Historical work on water in Delhi is outside the scope of the thesis but forthcoming from the author

both network and groundwater; and high-level corruption involving government contracts for work and services (Schneider & Schneider, 2008).

This is where greater specificity may help. The connection between illegal groundwater use and water tankers is explored in more detail in Malini Ranganathan's excellent paper on public authority which describes tanker owners as 'politician like' (Ranganathan, 2014a). The water supply from tubewells, tankers and the official network differs considerably. In my research, informal tanker management (both private, and public through side-payments, diversion and patronage) is business-like, as Björkman also suggests. However, tubewells (private and captured public) are 'state-like', primarily due to the natural monopoly tendencies of fixed pipes and productive wells.

The differential quantities of water supply are further differentiated by the different qualities of specific *modes* of supply. Different modes of water supply have different topologies and temporalities – which is to say they occupy space in different ways and durations (Mol & Law, 1994) – and consequently different visibilities. This also gives rise to different possibilities for politics, patronage, rent-seeking and capture. Tubewells are spatially discreet and relatively remote as well as being unobtrusive enough that they may be discretely located within a private residence. Tankers are mobile, with movements and cargoes that are hard to observe and verify, and are often operated by external contractors. The location of underground pipes and the movements of water across the government network are hazily understood at best, as are the relationships between user bills and water consumed. My finding here adds empirical detail from a particular case to Ahlers et al's observation of the importance of disaggregating 'water supply' in the abstract (Ahlers et al., 2014).

Informal water supply as a result of informal urbanisation in Sangam Vihar has allowed dominant castes in local villages to benefit from the urbanisation process in ways that do not appear to have happened in Malviya Nagar. In trying to account for the differences between Sangam Vihar and Malviya Nagar, it appears significant that while the Malviya Nagar area was urbanised formally, with acquisition of village land through the DDA for 'a pittance' in the 1960s and 70s, the informal urbanisation of Sangam Vihar appears to have

benefitted historically dominant caste groups in the villages of Deoli and Tughlakabad to which the land belonged. People from these groups were able to insert themselves into the urbanisation process and accumulate money and power through control of land sales, real estate development, politics and water at the expense of more recent migrants. In Malviya Nagar, this is less obvious. While powerful castes such as the Chauhans in Khirki still retain privileged positions, and some of the original landowners have become wealthy through compensation, development of the area's formal neighbourhoods has allowed a new set of much wealthier and more powerful residents to move in. Households with this level of wealth and influence would obviously not be interested in living in the unauthorised colony of Sangam Vihar. Instead, the upper class unauthorised colony of Sainik Farms has come up a short distance away. Here wealth insulates the residents from a lack of government services. Luxury villas are hidden behind high walls that run along the colony's private and gated roads. Households use deep bore tubewells and those residents without them can easily afford private water tanker deliveries.

Informal tenure leads to limited access to, and lower quality, urban services, which in turn leads to informal provision secured through informal intercession and politics. Control over land has led to influence over politics and water for the locally dominant castes and the exploitation of migrant settlers. My research in Delhi suggests that historically dominant groups have been able to use land, then real estate, then politics, then water to cement their control. The 2017 elections seem to support my findings which suggest the difficulty of using water reforms to challenge this entrenched resource-based power, at least in the short term.

While informalities in land, residential status, employment arrangements, state access, political patronage and urban services are related, *they are not the same*. Informal land settlement can allow the establishment of economically productive neighbourhoods by providing lower-cost, more flexible, better located, residential, industrial, commercial and community spaces than would otherwise be available to low-income people (Benjamin, 2004). For example, while informal land use may support mixed-use clusters with benefits for low-income residents, informal water use appears to primarily be of benefit in allowing the formal network to save the costs of expansion, local representatives to trade piecemeal

improvements for political loyalty and local entrepreneurs to generate income and a small amount of informal low-skill employment. Informal water supply then appears to be less beneficial than land and primarily valued in the absence of any alternative.

My research focus on water demonstrates the difficulties of thinking with a general theory of 'urban informality' drawn from empirical research on land or labour (AlSayyad, 2004; Benjamin, 2004; Kudva, 2009; Roy, 2005), and also suggests the difficulties of thinking across infrastructure modes (Marie-Hélène Zérah, 2008). Only within water, it should be apparent from my empirical work just how different informalities in piped supply, tanker provision and tubewell management are. There are challenges for generalisation across sites as well as infrastructure modes; Björkman's work on a low-income neighbourhood in Mumbai leads her to claim that talk of informality is performative (it 'produces the effects it names'). In my case, the situation is different, and the naming of an area *as* an 'unauthorised colony' by residents is an essential step in the process of formalisation.

The boundary between informal and formal blurs when you get close to it, rather like infrastructures or 'the state'. In response to characterisations of infrastructures as unexamined or unknown, these processes highlight a relational understanding of infrastructure where what is 'formal' is simply a question of scale and perspective; what is proximate, accessible and knowable changes with different actors (Star & Bowker, 2007). Sundaresan makes a similar point in his discussion of the informalised bureaucracy of planning in Bangalore (Sundaresan, 2013, p. 289). For low-income residents, the questions raised by other scholars – When are infrastructures? Who is infrastructure? Who and when is the state? – rather than rhetorical questions or conceptual flourishes, become essential elements of a viable coping strategy (Star & Ruhleder, 1996; Simone, 2004; Bawa, 2011; Ferguson & Gupta, 2002; Ghertner, 2017).

REFORMS

The uneven standard of water supply in such a wealthy and powerful city as Delhi raises the question of why progress has been so limited over previous decades. The series of rapid

changes brought about after the election of the Aam Aadmi Party government suggests that lack of political will by previous governments was indeed an element impeding reform.

Forms of 'vote bank politics' that leave the populations of unauthorised colonies reliant on ad hoc interventions from politicians for urban services, and the decreasing amounts and quality of groundwater have led to an electoral backlash. The 'success' of the strategy of governing populations at the expense of the effective governance of both network and underground water sources, was disrupted by the emergence of a new political party willing to challenge the existing situation. Voters' electoral rejection of 'business as usual' politics demonstrates the instability inherent in the previous regime.

However, the difficulty of establishing knowledge and control over water makes it an ideal subject for 'playing politics' – there are accusations of inefficiency, bias and corruption between rival political groups (Daily News and Analysis, 2016; Hindustan Times, 2014; Times of India, 2016a). The Aam Aadmi Party was able to channel dissatisfaction at unreliable expensive government water, and the low quality and declining yield of groundwater sources into a surprise electoral victory. Unfortunately, water is difficult to control; it is both extensive in time and space and highly localised. Relevant dimensions include both the wider Ganges basin and aquifers, personal or captured tubewells and diverted tankers, and longer-term processes which have transformed the hydroscapes of Northern India. The poor performance of the AAP in the Delhi 2017 elections suggests that while the party was able to channel dissatisfaction, the ongoing work of sustainable improvements is slower, and less spectacular.

If a party cannot ensure adequate water supply, it may be because they have connections to the water mafia, or conversely, because they have no control over the water mafia. They must be either corrupt or weak. I heard both these narratives levelled against politicians in power, and saw that lack of control 'on the ground' was a problem for AAP party workers attempting to reduce water misallocation. Remember Kamal (p91) who was willing to 'go to jail' if giving people water allowed him to 'make a name' in politics? There is a parallel here to the idea that criminal politicians are preferred by voters *because* of their ability to 'get work done' (Berenschot, 2013, p. 77; Vaishnav, 2017). The promise of reforming Delhi's

water governance relies not only on confronting powerful high-water use constituencies, but also on understanding and controlling the state water bureaucracy, informal groundwater use and the connections between them.

AAP bring an outsider perspective to government and a willingness to crowdsource and curate policy innovations. This has included interest in decentralised infrastructures such as water dispensers ('ATMS'). However, the move to pass a right to water connection regardless of tenure speaks to the AAP awareness of the potential for corruption and mismanagement in decentralised infrastructures (Bhan, 2016). While there may be positive examples from other locations, in my research, local decentralised infrastructures like tubewells and tankers appear to have greater potential for capture and diversion. The water supply modes used in Sangam Vihar are more personalised than network supply. The provision of off-grid and decentralised infrastructures like tubewells and tankers in lieu of a network connection allows for greater discretion by agency and political workers and appears more porous to external influence than network supply. There is greater input from the Members of Legislative Assembly, Sub-Divisional Magistrates, and Junior Engineers. Non-network sources display a greater propensity to discretionary allocation, diversion and capture than network water, are linked to city politics and embedded in local economies of caste, land and power. In this case study, it seems that, with the exception of bottled water supply, small-scale providers do not provide a desirable alternative to a piped network model. The failure of governance is important not only for water users, but also for water suppliers and economic and political power holders.

The decentralised modes of water supply through tankers, tubewells and bottles, because they are more localised and susceptible to local control, are also hard to reform, for the AAP and others. Ghertner uses the example of DJB employees who supply groundwater in Chhattarpur to suggest that the state can violate its own norms (operate as a Mobius strip in his topological terminology) (cf Ghertner, 2017). However, the example is based on a misunderstanding: groundwater extraction is not illegal if state agencies have failed to provide. In fact, groundwater provision by the DJB is extensive. Ghertner's example reiterates Roy's assertion that informality is state produced. In contrast, I suggest that while *sometimes*, state agencies find it convenient 'not to know', as in the DJB zone misalignment

discussed earlier, in many other cases they are *unable* to know or act. For example, state weakness means that the DJB is *unable* to use their own men as tubewell managers ('*kholnewalas*') in Sangam Vihar unlike Chhattarpur and other areas. This informality is not generated by state power, as Roy suggests, but by state weakness. Similarly, AAP reforms in Sangam Vihar appear to have underestimated the extent and resilience of local control over non-network sources. This has led to AAPs longer term strategy of reducing non-network sources altogether.

The Malviya Nagar Project shows the importance of understanding informal infrastructures as complex socio-technical systems. Insufficient appreciation for this led the MNC to approach the project without adequate awareness of the situation they were entering into and has continued to present difficulties for the project. The experience of the PPP project in Malviya Nagar suggests that the challenges of delivering uninterrupted water supply can be significantly underestimated. The deteriorated, modified and little-understood physical infrastructure in the project zone requires a substantial amount of work before relatively simple technology such as water meters and bulk flow meters can be used. Without a physical network of hydraulically sealed units, 'smart' water technology such as SCADA and hydrological modelling cannot be implemented.

A further complication is that the private company and the state agency do not enjoy high levels of mutual trust. Their relationship could be characterised as adversarial and competitive. The initial structuring of the water network improvement project – as an assessment of the private operator's suitability for the management of additional areas in the future – places private and public sector in competition, not partnership, with each other. The impact of PPPs on the distribution of knowledge for water management will depend on the contractual provisions and practical working relationships in each case. However, in a context of limited trust or competition, implicit or otherwise, with the public sector, there is a danger that just as public agencies may be unwilling to share information with their private sector rivals, understandings of network functioning with the potential for improved public services may be held with private for-profit companies. As current Indian urban policies, such as Smart Cities Mission and AMRUT, suggest PPPs as their 'preferred execution model' for urban development projects these tensions pose likely obstacles to the

smooth implementation of these programmes (Ministry of Urban Development, Government of India, 2015, p. 15).

Reforms such as the PPP project at Malviya Nagar, or the AAP's changes in Sangam Vihar do not necessarily reduce informality in urban service provision. Rather they change it, replacing some (such as illegal pipes or tubewell cartels in AAP strongholds), bypassing others (private tubewells and cartels in BJP strongholds) and introducing new informalities of their own (the relationship between the PPP and the DJB, the high cost of 'after the meter' leaks, differential ability to access decision makers). Even where informality appears to be reduced by rationalisation and commercialisation this operates as a transfer of power and knowledge to larger scales (wealthy local residents to multinational company, street cartels to local-level party workers). Understanding 'informality' as not restricted to one class or sector, suggests that the process of reducing 'corruption' in water governance and the introduction of private sector management may simply transfer discretion to larger scales or actors operating with different logics; financial concerns as opposed to social, to give a crudely simplified example.

Historical experience with private sector water management suggests that the rigidity of contracts is somewhat dependent on the social and political climate (P. B. Mehta, 2013). The regulation of water governance through contract, as in a PPP model, presents an assessment of the value of private sector management as hinged on the relative influence of state agencies, local governments, and their lawyers over private sector actors (often wealthy multinationals) against the relative influence and control of state agencies and local government over their own workers. Where the private sector has real independence from local political actors, private sector management may post a threat to informal arrangements and could therefore be seen as enabling of greater democratic responsiveness. However, in my case study, the social licence to operate is very real, and there are many ways for local politicians and residents to obstruct a project of this kind should they wish to. Given this context, it is important for resource management reform initiatives to include local representatives and secure their support. Numerical density of voters in low-income neighbourhoods gives them a key lever over elected representatives. The concerns mentioned above over distribution of knowledge, water and influence,

suggest the dangers of both the facile celebration of private sector management and an over-dogmatic rejection of it and should be seen as guides to future empirical research grounded in specific cases and across them.

WAYS FORWARD FOR RESEARCH AND PRACTICE

To summarise: My research suggests that key water governance roles, formal and informal, are personalised and discretionary and permeable to social power relations more broadly. This aspect of urban hydrology can vary from site to site, not just between regions of India, but also with size of settlement and even within a neighbourhood. In addition, its resilience to external interventions, poses greater challenges than network supply. Increases in transparency and accountability are as difficult as they are necessary. Further, the reliance on groundwater by both public and private actors offsets the costs of a lack of state water supply onto natural resources, remote places and future generations.

My findings indicate that the need for transparency and accountability of non-network water sources is an important dimension of improving water access in urban areas where the public network supply is limited. They also suggest that extension of the formal network is a preferable solution. Groundwater use is a very low quality urban water source and the aquifer degradation increases the importance of finding alternative methods. Lastly, PPPs under an operations and maintenance model are not necessarily anti-poor and can be a means of increasing service efficiency, given appropriate governmental oversight. However, while this is the case for the Delhi PPP studied, it may well be difficult to replicate elsewhere.

The time and resources available for this research have allowed a start on this work but it could be extended in several ways. Working on a politically and legally sensitive topic, access *was* challenging. This issue is also apparent in work by other researchers (Alankar, 2009; Borthakur, 2015; Ranganathan, 2014a). On a follow-up visit in 2017 I found access to be far easier, and I am planning for future work, to spend more time with politicians, party workers and neighbourhood-level brokers. This has particular salience given the contrast

between AAP's disappointing performance in Delhi's 2017 municipal elections and their strong majority in the 2015 Assembly elections. Relatedly given the scarcity of information on informal water use, and difficulty of access, more rigorous and comprehensive research into informal water businesses would be valuable in generating information as a first step towards understanding the operation of the sector.

I suggest that informal water access in some areas is linked to historically structured influence over land and politics. At the same time, it is a continuation of traditional, and still widespread, forms of decentralised water supply and delivery. I am continuing work on the development of Delhi's water supply over early modern, colonial and post-independence eras to trace the contemporary relevance of historical tendencies and transformations.

This study focussed primarily on two areas of South Delhi, Malviya Nagar, Sangam Vihar/Deoli, although I also conducted research interviews in other similarly situated areas (Chhattarpur, Shahpur Jat, Tigri, Khanpur, Deoli village) and visited many more. Working with the PPP in a large area of west Delhi which has a similarly high concentration of unauthorised colonies to Sangam Vihar would be the logical next step for a more comprehensive comparative extension of the research.

In regard to future research more widely, urban water supply in south Asia, its informalities, and relation to reforms is an area with rich scope for development. There are three directions that would repay investigation. India's Smart City Mission is promoting a more speculative approach to urban management, attempting to attract investors and lenders by safeguarding projects against political risk through a special project vehicle at city level (similar to the UKs urban development corporations). The majority of cities under the Mission have chosen area-based development projects. These are intended to have 24/7 water supply. As these smart city projects are only a small part of their respective cities, this seems likely to extend small-scale water PPPs across the country. However, without Delhi's political prominence, bureaucratic resources and civil society campaign on water privatisation, the design of contracts for these PPP initiatives may be less favourable. In Delhi it appears that the water originally intended for the PPP was in fact distributed across the city; however, in water PPPs in Pune and Nagpur, the opposite has happened:

neighbouring areas have seen a decline in availability as water is redirected to the higher-demand PPP areas. The effect of these new projects on water availability in their cities, their political accountability under the special project vehicle structure, and the effects that international investment under this model has on urban governance are future questions to be explored here.

A second stream of work would be to move from private-sector to public sector-led reforms. The latest wide-scale change in Delhi's water provision is the emergence of the AAP onto India's political scene with at least the promise of change (Naqvi, 2017). Unfortunately, many of these changes have been taking place since my fieldwork ended. As Delhi government the AAP has introduced water reforms from a progressive, populist perspective, rather than the commercial orientation that usually dominates. The AAP government reduced the cost of water connections for unauthorised colonies, introduced a lifeline free water tariff, and made it possible to apply for a water connection regardless of tenure status (Bhan, 2016). They have also attempted to counter corruption in the DJB, informal water supply and Delhi's privatisation initiatives. Since the AAP government came to power, the DJB has laid pipelines and released piped water in 101 unauthorized colonies, including some blocks of Sangam Vihar, and pipelines have also been laid in another 1033 colonies. Outside of Delhi, state-led reforms of urban water supply have also been taking place in Orissa and Maharashtra and appear to be progressive changes to the existing system, rather than grafting in enclaves of private expertise. This would appear to be a more sustainable model for India as a whole, yet I am unaware of research being done in this area. These reforms are mostly taking place in the smaller towns and cities, which tend to be neglected by academic research (de Bercegol, 2017; Denis & Zérah, 2017). As India urbanises these areas are the fastest growing, yet least resourced. Any opportunity for positive future impact over the country's urbanisation trajectory cannot afford to ignore these sites.

Lastly, a changing climate will severely impact life in south Asia, particularly in relation to surface and groundwater use. More erratic and reduced monsoons, increased flooding from glacial melting over the next decade and reduced river flow thereafter, combined with polluted and depleted aquifers are threats to social hydrology in a region which supports around a fifth of the world population. Developing understandings of the relationships

between urbanisation, water governance and reform are important now and will become increasingly urgent over time.

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APPENDIX WQ

Water quality measurements for locations in Project Area (Project DPR Appendices and DMA Report, 2011, p192)

Delhi Jal Board

Govt. of N.C.T. Delhi

Zonal Laboratory (South) Okhla Water Work, New Delhi-110025

Analysis Report of water Samples Collected from :

DJB Letter ref. No. F-7 (118)/EE (Project) W-VII/2010/1102 Dt/31.8.10			Locations of Tubewells & BPS																									
			A	B	C	D	E	F	G	H	I	A	B	C	D	E	A	C	D	B	E	F	G	A	B	C	D	E
			UGR CHIRAG DELHI	UGR SFS FLATS SHEIKH SARAI - I	T/W MAL-6 Nr. C-45 Malviya Nagar	T/W MAL-33 Nr. G.S/I3 Malviya Nagar	T/W Nr. Bhagat Singh park (old) MAL-21	T/W MAL-25 Nr. II-9 Malviya Nagar.	A-Block Shivalik	T/W MAL-113,Near PNB Geetanjali	T/W MAL-108,Near II.No-50,Navjivan Vihar	Booster- B Block Shivalik (BPS)	Booster Vijay Mandal Enclave (BPS)	Tubewell Bhagat Singh College Chirag Delhi (GRE-60)	Tubewell Dadhichi Mohalla Chirag Delhi (GRE-66)	Booster Community Sheikh Sarai Ph_I (BPS)	Tubewell Jagdamba Camp-2 (GRE-79)	Tubewell Gupta Colony-Nr Transformer Khirki Ext. (GRE-96)	Tubewell J-6/50 Khirki Ext (GRE-91)	Booster DDA Flat Khirki	Booster Hauz Rani	Tubewell MAL-51 NIL Block Malviya Nagar	Tubewell No. 66 Near Sai Mandir Khirki Village Malviya Nagar (MAL-66)	Twell Near 551 Chirag Delhi (GRE-56)	Tubewell No. 1 Barat Ghar Chirag Delhi (GRE-57)	Tube well No.2 Auto Clinic Chirag Delhi (GRE-65)	Tubewell No. 1 Auto Clinic Prajapati Mohalla Chirag Delhi (GRE 64)	Tubewell MAL-49, Near T-II Toot Sarai Malviya Nagar
S.No.	PARTICULARS	UNIT	RESULT																									
	Physical Examination -																											
1	Date of Collection / Receipt -											22/9/2010	22/9/2010	22/9/2010	22/9/2010	22/9/2010	23/9/2010	23/9/2010	23/9/2010	23/09/2010	23/09/2010	20/09/2010	20/09/2010	20/9/2010	20/9/2010	20/9/2010	20/9/2010	20/9/2010
2	Colour / Clarity -	Hazen	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear
3	Odour		Nothing objectionable			Nothing objectionable			Nothing objectionable			Nothing objectionable					Nothing objectionable							Nothing objectionable				
4	Turbidity (5-10)	(N.T.U.)	3.66	3.68	4.16	4.18	4.68	4.66	4.18	4.18	4.1	3.68	3.69	3.71	3.89	3.9	3.97	3.98	3.97	4.18	3.99	4.68	4.78	3.8	3.6	4.18	4.16	4.15
5	pH. Value (6.5-8.5)		7.8	7.8	7.8	7.8	7.8	7.6	7.6	7.8	7.6	7.3	7.3	7.6	7.1	7.2	7.2	7.2	7.2	7.3	7.4	7.3	7.2	7.5	7.2	7.2	7.3	7.2
6	Electrical Conductance	(μ mhos / cm^{25})	197.8	195.5	337	1178	817	1151	1199	443	1443	189	222	1236	1938	1144	1164	1802	2266	1568	779	1985	1770	1391	1355	1446	1816	1729
7	T.D.S (500-2000 mg/l)	(mg/l)	94.6	93.5	162.2	489	399	567	592	214	814	90	106	610	972	563	574	904	1143	780	380	997	885	689	671	718	909	864
	Chemical Examination :																											
1	Phenolphthalein Alkalinity	(mg/l)	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
2	Total Alkalinity (as $CaCO_3$) (200-600)	"	86	76	96	176	166	300	300	120	382	70	70	182	382	318	288	258	258	264	214	290	264	332	382	350	358	330
3	Total Hardness as $CaCO_3$ (300-600 mg/l)	"	94	86	108	350	304	356	318	146	326	80	82	240	696	456	380	700	780	238	244	728	538	256	298	468	690	650
4	Carbonate Hardness (mg/l)	"	86	76	96	176	166	300	300	120	326	70	70	82	382	318	288	258	258	238	214	290	264	256	298	350	358	330
5	Non Carbonate hardness	"	8	10	12	174	138	56	18	26	NIL	10	12	58	314	138	92	442	522	NIL	30	438	274	NIL	NIL	118	332	320
6	Calcium Hardness	"	60	56	72	204	180	202	168	108	188	60	68	130	400	268	252	400	480	120	100	406	308	144	184	306	420	348
7	Magnesium Hardness	"	34	36	36	146	124	154	150	38	138	20	14	110	296	188	128	300	300	118	144	322	230	112	102	162	270	302
8	Ammonia (Free & Saline as N)	"	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
9	Nitrites (as N)	"	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
10	Nitrates (as NO_3) (45 mg/l)	"	ND	ND	61	79	44	24.5	18	60	10.25	ND	ND	31	300	129	78	142	375	9	44	129.8	129.8	22.5	71	129	129	120
11	Chloride (as Cl) (250-1000 mg/l)	"	12	12	22	34	42	50	10	32	16	10	14	242	192	112	134	266	336	316	72	250	252	172	114	136	184	192
12	Sulphate (as SO_4) (200-400 mg/l)	"	39.8	40.4	46.7	129.1	34.49	87.5	62	137.2	98.4	9	11.3	49.2	72.6	66.2	23.6	129.2	40.8	18.8	32.8	148	58	117.4	120.8	106.2	178	175.8
13	Iron (as Fe) (0.3-1.0 mg/l)	"	0.02	0.02	0.04	0.06	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.02	0.02	0.02	0.02	0.02	0.04	0.04	0.02	0.02	0.02	0.04	0.04
14	Fluoride (as F) (1.0-1.5 mg/l)	"	0.15	0.18	0.62	0.68	0.56	0.58	0.88	0.62	0.68	0.34	0.3	0.82	0.68	0.4	0.86	0.98	1.12	0.84	0.68	1.1	0.86	0.86	0.78	1.12	1.18	0.98
15	Calcium (as Ca) (75-200 mg/l)	"	24	22.4	28.8	81.6	72	80.8	67.2	43.2	75.2	24	27.2	52	160	107.2	100.8	160	192	48	40	162.4	123.2	57.6	73.6	121.6	168	139.2
16	Magesium (as Mg) (30-150 mg/l)	"	8.16	8.64	8.64	35.04	29.76	36.96	36	9.12	33.12	4.801	3.36	26.4	71.04	45.12	30.72	72	72	28.32	34.56	77.28	55.2	26.88	24.48	38.88	64.8	72.48
17	Chromium (as Cr^{6+} (0.05 mg/l)	"	ND	ND	ND	ND	ND	ND	ND	ND	ND																	
18	Cyanide (as CN) (0.05-1.5 mg/l)	"	ND	ND	ND	ND	ND	ND	ND	ND	ND																	
19	Copper (as Cu) (0.05-1.5mg/l)	"	ND	ND	ND	ND	ND	ND	ND	ND	ND																	
20	Residual Chlorine	"	1.0	1.25	NIL	NIL	NIL	NIL	NIL	NIL	NIL	1.0	0.75	NIL	NIL	NIL	NIL	NIL	NIL	NIL	0.5	NIL	NIL	NIL	NIL	NIL	NIL	NIL
	Remark by DJB Laboratory		On the Basis of parameters tested, water source of Sr. No. A&B confirms the IS code,so fit for drinking purpose and Sr. No. C does not confirms the IS code. Hence Unfit for Drinking purpose.			On the basis of parametrs tested, water source of Sr. No. D does not confirms the IS code. So unfit for Drinking and E&F confirms the IS code, so fit for Drinking purpose only after proper chlorination & disinfecteant.			On the basis of parameter tested Sr.No- H does not confirms to IS Code Hence Unfit for Drinking Purpose and Sr.No-G & I confirms the IS code considered Fit for thr Drinking Purpose only after proper Chlorination and Disinfectent.			On the basis of parameters tested, water source confirms the above IS code, so all are fit for Drinking purpose.			On the basis of parameters tested, both do not confirms the above IS code. So Unfit for Drinking purpose.		On the basis of parameters tested, all do not confirms the above IS code. So Unfit for Drinking purpose.			On the basis of parameters tested, water sources confirms the above IS code. So Fit for Drinking purpose.		On the basis of parameters tested, both do not confirms the above IS code. So both are Unfit for drinking purpose.		On the basis of parameters tested, water source confirm to above IS code. So Fit for Drinking	On the basis of parameters tested, water sources do not confirms the IS code. So both are Unfit for Drinking purpose.		On the basis of parameters tested, water sources do not confirms the IS code. So both are Unfit for Drinking purpose.	
	Remarks : As per IS-10500-1991 reaffirmed 1993 ed 2.2 (2003-09)																											
	Testing Date-		20-9-2010	20-9-2010	20-9-2010	20-9-2010	20-9-2010	20-9-2010				23-9-2010	23-9-2010	23-9-2010	23-9-2010	23-9-2010	24-9-2010	24-9-2010	24-9-2010	24-9-2010	24-9-2010	24-9-2010	24-9-2010	24-9-2010	24-9-2010	24-9-2010	24-9-2010	24-9-2010

APPENDIX WU

Water use and billing for locations in Project Area (Project DPR Appendices and DMA, 2011, p175)

Consumer Database Deatails (2009-2010)																		
Sr. No.	Project Area Locations	Zone	I	IA	II	IIA		No of consumers	AREAR (Rs)	CONSUM PER YEAR(Kilo litres)	CONSUM PER DAY (Kilo litres)	ACSCHARG (Rs) (A)	WTRCHARG (Rs) (B)	ADDPERCENT (Rs) (C)	CESS (Rs) (D)	MRENT (Rs) (E)	Water Bill (Rs.) (A+B+E)	DEMAND (Rs
1	HAUZ RANI & VILLAGE	SW-III	2	864	70	0		937	5780496	213897	586	649877.93	446063.12	231800.55	4277.94	10854.78	1106795.83	1342874.32
2	MMTC (Bulk)	SW-III	2					2	-	148273	406	209053.34	373563.01	205602.06	2965.46	0	582616.35	791183.87
3	MALVIYA NAGAR	SW-III	17	5603	447	11		6076	10505403.27	1486120	4072	4258975.14	5832694.52	2909163.35	28898.99	47116.42	10138786.08	16773455.66
4	BEGUM PUR	SW-III	1	542	53	0		597	1246100	124713	342	338995.85	552541.39	278309.12	2496.74	2318.96	893856.2	1174662.06
5	NAV JEEWAN VIHAR	SW-III	0	270	22	0		292	508298.65	84181	231	234891.6	460038.51	236275.71	1626.9	4278.48	699208.59	937111.2
6	KHIRKI VILLAGE &Khirki EXT	SW-III	1	2770	63	0		2834	43251755.07	523086	1433	1339672.84	1108963.57	318732.22	12994.19	366.41	2449002.82	2780729.23
7	SHIVALIK	SW-III	3	1070	127	0		1200	1730251	342689	939	1044969.19	1634967.46	809546.46	6918.68	2289.92	2682226.57	3498691.71
8	SARVODYA ENCLAVE	SW-III	1	779	32	0		812	1321000	259992	712	810727.25	1308702.62	657022.99	5188.36	7271.39	2126701.26	2788912.61
9	ADHCHINI	SW-III	2	234	73	0		309	1808033	60407	165	288537.16	227525.67	119181.38	1208.14	3565.59	519628.42	640017.94
10	GEETANJALI ENCLAVE	SW-III	0	383	22	0		405	745219	145545	399	345940.06	710179.18	356900.01	2955.08	4641.79	1060761.03	1420616.12
11	SARVPRIYA VIHAR	SW-III	1	654	34	0		689	1115599.33	249299	683	617844.83	812307.63	347530.52	5174.94	10026.92	1440179.38	1792884.84
12	KALU SARAI	SW-III	0	471	68	1		540	2222746	290925	797	418291.36	6501495.45	3435593.74	5780.32	6852.66	6926639.47	10368013.53
13	LADO SARAI	S-I	2	1966	63	1		2032	5335086	400310	1097	934185.88	705261.7	354648.38	8006.2	0	1639447.58	2002102.16
14	SADULAJAB	S-I	494	204	26	0		724	55206	111904	307	427919.64	233085.82	120480.05	2238.08	665.84	661671.3	784389.43
15	SAKET	S-I	3	4231	262	4	4500	4500	3900933.81	1143396	3133	3461602.31	4318979.05	2206142.23	24783.99	45596	7826177.36	10057103.58
16	KATWARIYA SARAI	S-I	1296		86			1382	0	368498	1010	927451.19	1734404.82	894199.62	7330.36	5590.17	2667446.18	3568976.16
17	QUTAB INSTITUTIONAL AREA	S-I	6		38			44	0	120441	330	204730.63	4481786.84	2424763.63	2408.82	181.01	4686698.48	7113870.93
18	IGNOU	S-I	2		12			14	0	74070	203	96593.33	2480583.97	1327781.75	1481.4	0	2577177.3	3906440.45
19	NEB SARAI	S-I	537		14			551	0	63082	173	302947.59	79594.84	6708.59	1261.64	0	382542.43	390512.66
20	PUSHP VIHAR (BULK CONSUMER)	S-I	1		0			1	0	828440	2270	4069573.34	615548	317228	16568.8	0	4685121.34	5018918.14
21	CHIRAG DELHI	S-III	4	2497	86	0		2587	4540722.01	570232.43	1562	1314756.06	1640503.82	836418.31	13435.82	28447.32	2983707.2	3831283.11
22	SHEKH SARAI PHASE-I	S-III	2	1095	48	0		1145	796282	267988	734	773957.86	584440.88	299687.96	5317.96	7690.15	1366088.89	1671094.81
23	SAVITRI NAGAR	S-III	4	1628	93	0		1725	3636851.04	344391	944	1119184.34	725925.16	340706.01	6452.52	18193.48	1863302.98	2210461.51
24	SWAMI NAGAR	S-III	2	367	34	0		403	1058079.32	141287	387	428877.84	826652.93	427732.87	2825.08	1781.57	1257312.34	1687870.29
25	PANCHEEL PARK (S-BLOCK)	S-III	-	616	101	7		724	1818044.7	262258	719	1008527.5	1932151.84	975384.19	5276.44	3577.78	2944257.12	3924917.75
26	SADHANA ENCLACE	S-III	1	107	5	0		113	140616	43025	118	140275.33	218917.09	109458.51	860.5	135.33	359327.75	469646.76
27	SHAEKH SARAI PHASE-II	S-III	1466		44			1510	766895.89	337912	926	871355.88	706532.48	360259.26	6804.26	13147.64	1591036	1958099.52
	TOTAL		3850	26351	1923	24		32148	92283618	9006361	24675	26639715	41253411	20907257	185538	224590	68117716	92904840
										24.67	ML PER DAY							

APPENDIX MR

Meter Replacements by DJB before start of PPP (PPP Detailed Project Report Appendices and Demand Management Area Report, 2011, p188)

Summary of meter Replacement done by DJB					
SR.NO	AREA	ZONE	No. of Meter Replaced	CONSUMPTION Before Replacement 2008-2009	CONSUMPTION after Replacement 2009-2010
1	MAHRAULI HAUZ RANI & VILLAGE	SW-3	1	246	245
2	MALVIYA NAGAR	SW-3	531	133062	149243
3	BEGUM PUR,VILLAGE,PARK	SW-3	51	12122	14957
4	NAV JEEWAN VIHAR	SW-3	14	3513	8753
5	KHIRKI VILLAGE AND EXT 455	SW-3	34	7296	8272
6	SARVODYA ENCLAVE	SW-3	145	41751	59404
7	ADHCHINI	SW-3	4	1150	2049
8	GEETANJALI	SW-3	22	6473	11524
9	SARVPRIYA VIHAR	SW-3	167	51618	48422
10	KALU SARAI	SW-3	70	16881	21831
11	SAKET	S-1	159	39800	40579
12	KATWARIYA SARAI	S-1	130	0	41792
13	CHIRAG DELHI	S-3	506	122454	140611
14	SAVITRI NAGAR	S-3	62	14850	9360
15	SWAMI NAGAR	S-3	43	11278	18718
16	PANCHEEL PARK (S-BLOCK)	S-3	77	28426	30293
TOTAL			2016	490920	606053

APPENDIX PD

Population density in PPP zone (PPP Detailed Project Report: p74-75)

DJB Malviya Nagar Project Detailed Project Report (JNNURM ToolKit)

Sr. No.	Name of Colony	Bulk	Total Area (Ha)	Non Useable Area	Useable Area	Density for Yr.2010 (Person Per Ha)	Pop. Yr.2010	Density for Yr.2011 (Person Per Ha)	Pop. Yr.2011	Density for Yr.2026 (Person Per Ha)	Pop. Yr.2026	Density for Yr.2041 (Person Per Ha)	Pop. Yr.2041
1	Malviya Nagar		67.445	0.8407	66.6043	295.00	19647	412.00	27454	579.00	38556	763.00	50834
2	Saket		137.15	2.7236	134.4264	262.00	35242	305.00	40997	413.00	55508	529.00	71052
3	Sheikh Sarai Phase-I		31.307	0.6119	30.6951	233.00	7140	288.00	8851	448.00	13756	602.00	18466
4	Seikhsarai-Phase-II		36.229	0.4621	35.7669	162.00	5790	194.00	6922	244.00	8732	318.00	11358
5	Shivalik		23.4685	0.0754	23.3931	155.00	3621	263.00	6164	407.00	9532	546.00	12766
6	Punchsheel		19.486	0.1422	19.3438	93.00	1803	168.00	3257	251.00	4860	333.00	6432
7	Sarvodaya Enclave		13.54	0.1189	13.4211	429.00	5763	486.00	6521	649.00	8708	821.00	11021
8	Navjeeven Vihar		6.8865	0.0775	6.809	184.00	1255	248.00	1690	351.00	2387	452.00	3075
9	Swami Nagar		18.5989	0.4974	18.1015	38.00	686	61.00	1107	95.00	1721	127.00	2307
10	Sadhana Enclave		13.5426	0.1493	13.3933	60.00	802	130.00	1744	207.00	2767	276.00	3693
11	Sarvpriyavihar		21.7727	0.3772	21.3955	191.00	4089	265.00	5680	363.00	7765	467.00	9990
12	Geetanjali		14.55	0.1104	14.4396	154.00	2227	188.00	2721	262.00	3777	335.00	4835
13	MMTC-STC+PTS	Bulk	39.3264	0.0608	39.2656	131.00	5139	132.00	5169	161.00	6304	194.00	7609
14	Savitri Nagar		7.8242	0	7.8242	492.00	3853	1015.00	7940	1626.00	12724	2136.00	16714
15	Kalu Sarai(Vijay Mandal)		28.2783	0.174	28.1043	112.00	3139	141.00	3975	192.00	5401	246.00	6925
16	Begampur		18.7276	0.2116	18.516	282.00	5214	353.00	6543	584.00	10817	786.00	14557
17	Chirag Delhi		37.2738	0.1442	37.1296	369.00	13709	442.00	16394	673.00	25004	894.00	33176
18	Khirhi +DDA Flats+Extension		52.8052	0.5637	52.2415	687.00	35895	834.00	43567	1110.00	57983	1448.00	75626
19	Hauz Rani		16.6672	0.1105	16.5567	871.00	14426	944.00	15626	1303.00	21567	1641.00	27163
20	Pushp Vihar		226.46	0	226.46	159.00	35908	159.00	35908	190.00	43090	228.00	51708
21	Qutub Inst. Area		77.59	0.19861	77.3913	65.00	5031	70.00	5395	98.00	7603	120.00	9316
22	Katwaria Sarai		29.15	0.0563	29.0937	530.00	15419	618.00	17966	826.00	24022	1013.00	29468
23	Lado Sarai		119.33	5.9959	113.334	127.00	14373	154.00	17425	231.00	26208	304.00	34471
24	Adhichini		36.8805	0	36.880	37.00	1365	46.00	1699	71.00	2603	93.00	3414
25	Neb Sarai inc. Harijan Basti		98.695	1.0708	97.624	98.00	9537	129.00	12572	213.00	20822	281.00	27459
26	Sayed-Ul-Jab Inc. Paryavaran Colony		123.99	1.2843	122.705	610.00	74793	644.00	79066	747.00	91629	820.00	100577
27	IGNOU	Bulk	66.783		66.783								
		TOTAL	**1383.7574**	**16.05731**	**1367.7001**		**325866**		**382353**		**513846**		**644012**